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# Acceptability of Doxycycline Prophylaxis, Prior Antibiotic Use, and Knowledge of Antimicrobial Resistance Among Australian Gay and Bisexual Men and Nonbinary People

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**Background:** There is growing interest in novel sexually transmissible infection (STI) prevention strategies, including doxycycline postexposure prophylaxis (doxy-PEP). We assessed interest in doxy-PEP and other STI prevention strategies among gay and bisexual men and nonbinary people in Australia, as well as prior antibiotic use for STI prevention, and knowledge of antimicrobial resistance (AMR).

**Methods:** We conducted a national, online survey in June to July 2023. Multivariable logistic regression was used to identify factors associated with the acceptability of doxy-PEP.

**Results:** Of 2046 participants, 26.9% had been diagnosed with an STI in the previous year. Condoms were rated as an acceptable STI prevention strategy by 45.1% of the sample, STI preexposure prophylaxis by 54.0%, and doxy-PEP by 75.8%. Previous antibiotic use for STI prevention was reported by 7.5% of the sample, and 2.6% were currently using antibiotics for STI prevention. Over half the sample (62.1%) had some knowledge of AMR. Of those who knew something about AMR, 76.2% were concerned about it. Interest in using doxy-PEP was independently associated with previous use of antibiotics for STI prevention (adjusted odds ratio, 3.09; 95% confidence interval, 1.78–5.35;  $P < 0.001$ ), whereas those who were concerned about AMR were less interested in it (adjusted odds ratio, 0.51; 95% confidence interval, 0.36–0.72;  $P < 0.001$ ).

**Conclusions:** Doxycycline postexposure prophylaxis was highly acceptable to gay and bisexual men and nonbinary people in Australia, and few factors distinguished between interest in using it or not. We recommend community and professional discussion and education about the effective use of doxy-PEP, AMR, and who would most benefit from doxy-PEP.

Gay, bisexual, and other men who have sex with men (GBM) are one of the groups who are overrepresented in diagnoses of sexually transmissible infections (STIs), due to a higher average number of sexual partners, denser sexual networks, and higher frequency of testing than heterosexual peers.<sup>1,2</sup> In the first 2 decades of the HIV epidemic, GBM in high-income countries like Australia typically reported higher levels of condom use than their heterosexual peers to prevent HIV transmission,<sup>3,4</sup> which helped suppress STI transmission.<sup>5</sup> However, levels of condom use by GBM have gradually fallen since 2000.<sup>4</sup> In the last decade, condom use by GBM has declined further in settings where the use of HIV preexposure prophylaxis (PrEP) has become more common,<sup>6,7</sup> and high STI incidence has been observed in HIV PrEP users.<sup>8</sup>

Recognizing the ongoing burden of disease that STIs cause and the need for alternatives to barrier methods like condoms, the last decade has seen growing interest in new biomedical prevention strategies for STIs. There have been trials to assess the efficacy of antibacterial mouthwash in reducing pharyngeal infections, which found that it is ineffective.<sup>9,10</sup> Studies have also assessed the use of oral antibiotics (specifically doxycycline) to prevent STIs, by taking either a pill every day as PrEP (doxy-PrEP), or 1 or 2 pills after sex as postexposure prophylaxis (doxy-PEP).<sup>11</sup> Recent studies of doxy-PEP in men who have sex with men, transgender women, people living with HIV, and HIV PrEP users have found beneficial results, with a single dose of doxycycline (200 mg) taken within 72 hours of exposure reducing the incidence of bacterial STIs, with greater efficacy in preventing syphilis and chlamydia than gonorrhea.<sup>12–14</sup>

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Concerns about the potential for adverse effects like antimicrobial resistance (AMR) have led some advisory groups to remain cautious about doxy-PEP or PrEP, while recognizing that there is already some use of antibiotics for this purpose by GBM.<sup>15,16</sup> A consensus statement about doxy-PEP issued from Australia suggested that it would be of most benefit to GBM who had been recently diagnosed with syphilis or more than one STI in the previous year, or GBM who anticipated a period of heightened risk (such as a holiday or party season), with a recommendation to review use after 3 to 6 months.<sup>16</sup> Research with GBM in Australia and North America has found high levels of interest in doxy-PEP and PrEP,<sup>17–20</sup> but has not compared interest in different STI prevention strategies in a whole-of-community sample. We surveyed GBM and nonbinary people across Australia about the acceptability of different STI prevention strategies, prior use of antibiotics for STI prevention, and knowledge and concerns about AMR. We also assessed the characteristics of GBM and nonbinary people interested in doxy-PEP, responding to recommendations to assess community views about the strategy.<sup>16</sup>

## METHODS

### Study Design and Participants

Data were collected in a national, online, cross-sectional survey of GBM and nonbinary people conducted in June to July 2023.<sup>21</sup> The primary purpose of the project (conducted every 2 years since 2011) is to assess community attitudes to HIV prevention strategies and sexual health. Eligible participants were at least 16 years old, gay, bisexual, or queer-identified, male or nonbinary gender, and resident in Australia. The study design was approved by the Human Research Ethics Committee of UNSW Sydney (HC230024) and the community organization ACON's research review panel (D202301).

The survey was promoted using paid advertising on the social networking platforms Facebook and Instagram in English, Mandarin, and Thai and on the geosocial dating/hook-up app Grindr in English. Participants of previous survey rounds who had consented to be contacted were sent an email inviting them to take part in the 2023 round, and links to the survey were also circulated on social media and to community organizations that work with GBM and nonbinary people. Potential participants who clicked on an ad or link were directed to the survey website and shown the participant information statement. Participants provided positive consent (ticking a box confirming that they understood what the study was about), and then commenced the online questionnaire.

The online questionnaire was created and hosted on Qualtrics survey software (Provo, UT). The software automatically adjusts the appearance of the questionnaire to different screen sizes and uses adaptive routing (only presenting questions that are relevant to participants, based on their previous answers). The first questions of the survey were used to confirm participant eligibility and exclude people who were ineligible.

### Measures

The questionnaire assessed participants' demographics, for example, age, country of birth, education level, employment status, gender, sexual identity, and state or territory of residence. The questionnaire also asked participants about their recent sexual practices and relationships (with male, female, and nonbinary partners), HIV status and testing history, STI testing and recent diagnoses, use of HIV treatment, and HIV PrEP. These variables were used to describe the sample and as covariates in the multivariable analyses.

The acceptability of different STI prevention strategies (condoms, doxy-PrEP, and doxy-PEP) was measured with three attitudinal items, "I use condoms to avoid getting STIs," "I would take low dose antibiotics regularly if it would prevent me getting STIs," and "I would take an antibiotic pill after sex if it would prevent me getting STIs." Participants were asked how much they agreed with each item, on a 5-point Likert scale (strongly disagree = 1, disagree = 2, neither disagree nor agree = 3, agree = 4, strongly agree = 5). Participants who agreed or strongly agreed with each item were classified as regarding that strategy as acceptable (vs. participants who strongly disagreed, disagreed, or were neutral about each strategy). Participants were not provided with any definitions or explanations about doxy-PrEP or doxy-PEP in this part of the survey.

Participants were asked, "Have you ever taken antibiotics around the time of sex to reduce the risk of getting an STI? This is sometimes referred to as doxy-PEP or doxy-PrEP" (yes/no). If participants indicated they had previously used antibiotics for STI prevention, they were asked where they had sourced the antibiotics, and their dosing strategy if they were currently using antibiotics.

Familiarity with and concern about AMR were asked with 2 questions, "How much do you know about antimicrobial resistance?" with 5 answer options from nothing (1) to a great deal (5), and "How concerned are you about antimicrobial resistance?" from not at all concerned (1) to very concerned (5). Only participants who indicated they knew something about AMR (response options 2–5) were asked the second question.

### Analyses

Statistical analyses were performed using Stata version 16.1 (StataCorp, College Station, TX). Frequencies and proportions are reported for demographic and behavioral variables. Bivariable associations were assessed using  $\chi^2$  tests and logistic regression. Multivariable ordered logistic regression was used to identify independent associations with knowledge of AMR (from 1 = none to 5 = a great deal). Multivariable logistic regression was used to identify independent associations with the acceptability of doxy-PEP, with the outcome dichotomized (not acceptable vs. acceptable). Covariates that were statistically significant at the bivariable level ( $P < 0.05$ ) were block entered into the multivariable analyses. Statistical assumptions were assessed, including model diagnostics for logistic regression, none of which were violated. Variables in the regression models had no missing observations. We report unadjusted and adjusted odds ratios (OR and AOR) with 95% confidence intervals (CIs). Statistical significance was set at  $P < 0.05$  (2-tailed).

## RESULTS

The survey was started by 2568 and completed by 2046 eligible participants. Most participants completed the survey in English, and 103 completed it in Mandarin or Thai. Of the 2046 participants, the median age was 35 years (interquartile range, 27–46 years). Participants identified as gay (81.7%), bisexual (13.5%), queer (3.9%), or another identity (0.8%). Most participants were cisgender men (95.0%), with smaller proportions of transgender men ( $n = 44$ ; 2.2%) and nonbinary people ( $n = 58$ ; 2.8%). Participants were most likely to live in New South Wales (32.4%), Victoria (27.8%), or Queensland (18.6%), followed by the other states and territories (21.3%). Most participants lived in the capital city of their state or territory (70.1%). Most participants were Australian born (69.9%), with 13.4% born in Asia and 7.5% in Europe. Forty-five participants (2.2%) were Aboriginal Australians or Torres Strait Islanders. Most participants were university educated (64.0%), were in full-time employment (68.0%), and had access to Medicare (90.3%), Australia's universal health insurance

system, which subsidizes access to health care services and medicines. In terms of HIV status and HIV PrEP use, 9.6% of participants were untested or of unknown HIV status, 37.3% were HIV negative and not using PrEP, 46.3% were HIV negative and using PrEP, and 6.8% were living with HIV. More than two-thirds of the sample had been tested for HIV (72.1%) or other STIs (70.6%) within the year preceding the survey, and over a quarter of the sample (26.9%) had been diagnosed with any STI in the same period. Additional participant characteristics are shown in Table 1.

### Acceptability of Different STI Prevention Strategies

In the whole sample ( $N = 2046$ ), condoms were rated as an acceptable STI prevention strategy by 45.1% ( $n = 922$ ), doxy-PrEP by 54.0% ( $n = 1104$ ), and doxy-PEP by 75.8% ( $n = 1550$ ). The acceptability of different strategies varied by HIV status and PrEP use. The use of condoms to prevent STIs was most acceptable to HIV untested and unknown status participants (71.4%), followed by HIV-negative participants not taking PrEP (61.4%), PrEP users (29.4%), and participants living with HIV (26.6%);  $\chi^2[3, 2046] = 248.14, P < 0.001$ ). Doxy-PrEP was most acceptable to HIV untested and unknown status participants (61.7%), followed by PrEP users (59.1%), participants living with HIV (51.8%), and HIV-negative participants not using PrEP (45.9%);  $\chi^2[3, 2046] = 35.00, P < 0.001$ ). Doxy-PEP was most acceptable to HIV-untested or unknown status participants (81.1%), followed by PrEP users (78.1%), participants living with HIV (72.7%), and HIV-negative participants not using PrEP (72.0%);  $\chi^2[3, 2046] = 12.64, P = 0.005$ .

### Prior Use of Antibiotics to Prevent STIs

A minority of the sample ( $n = 154$ ; 7.5%) had ever used antibiotics to prevent STIs. Previous antibiotic use for STI prevention was more common among PrEP users and participants living with HIV (10.6% and 10.1%, respectively) compared with HIV-negative participants not using PrEP and untested/unknown status participants (4.2% and 4.1%, respectively);  $\chi^2[3, 2046] = 29.38, P < 0.001$ . The most common sources of antibiotics for STI prevention were a prescription from a doctor (47.4%), repurposing antibiotics the participants had kept (37.7%), receiving antibiotics from a peer (11.0%), getting antibiotics online without a prescription (10.4%), or from a clinical trial (6.5%). Among the 53 participants who were using antibiotics to prevent STIs at the time of the survey (2.6% of the whole sample), most were taking 2 pills after sex ( $n = 30$ ; 56.6%), some were taking antibiotics daily or most days ( $n = 12$ ; 22.6%), and the remainder were taking antibiotics another way ( $n = 11$ ; 20.8%).

### Knowledge and Concern About AMR

Of the whole sample ( $N = 2046$ ), 775 (37.9%) indicated that they knew nothing about AMR, 816 (39.9%) knew a little or moderate amount, and 455 (22.2%) knew a lot or a great deal. The ordered logistic regression of factors associated with knowledge of AMR is shown in Table 2. The multivariable analysis showed that less knowledge of AMR was associated with increasing age in years (AOR, 0.98; 95% CI, 0.97–0.99), and being born in Asia compared with Australia (AOR, 0.56; 95% CI, 0.42–0.74;  $P < 0.001$ ). Greater knowledge of AMR was associated with having a university degree compared with a high school or trade qualification (AOR, 2.58; 95% CI, 2.15–3.09;  $P < 0.001$ ), having Medicare coverage versus not (AOR, 1.63; 95% CI, 1.17–2.27;  $P = 0.004$ ), being a PrEP user versus HIV negative not on PrEP (AOR, 1.26; 95% CI, 1.01–1.57;  $P = 0.04$ ), and consistent condom use with regular male partners (AOR, 1.75; 95% CI, 1.20–2.55;  $P = 0.003$ ). This analysis also controlled for HIV

and STI testing history, recent diagnoses with STIs, and number of recent male partners, as they were statistically significant at the bivariable level.

Among participants who knew something about AMR ( $n = 1271$ ), most were concerned or very concerned about it ( $n = 968$ ; 76.2%). Greater self-reported knowledge about AMR was associated with greater levels of concern about AMR; for example, 56.5% of participants who knew “a little” about AMR were concerned or very concerned about it compared with 91.5% of participants who knew “a great deal” about AMR ( $\chi^2[6, 1271] = 146.29, P < 0.001$ ). Concern about AMR also varied by HIV status and PrEP use, with concern about AMR expressed by 63.4% of HIV untested and unknown status participants, 77.9% of HIV-negative participants not taking PrEP, 77.9% of PrEP users, and 69.1% of participants living with HIV ( $\chi^2[6, 1271] = 13.20, P = 0.04$ ).

### Factors Associated With Interest in Using Doxy-PEP

Table 1 shows the analysis of factors associated with willingness to use (the acceptability of) doxy-PEP. Interest in using doxy-PEP was unrelated to most sociodemographic variables, recent HIV and STI testing history, being recently diagnosed with an STI, and number of recent male sexual partners. At a bivariable level, university-educated participants and participants who reported knowing more about AMR were less likely to indicate that doxy-PEP was acceptable, whereas untested/unknown status participants, PrEP users, and participants who had had condomless sex with casual male partners were more interested in using it. In the multivariable model, the only factors that were independently associated with interest in using doxy-PEP were previous use of antibiotics for STI prevention (AOR, 3.09; 95% CI, 1.78–5.35;  $P < 0.001$ ) and concern about AMR (AOR, 0.51; 95% CI, 0.36–0.72;  $P < 0.001$ ).

## DISCUSSION

We compared the acceptability of different STI prevention strategies in a national sample of gay and bisexual men and nonbinary people in Australia. We found that doxy-PEP was acceptable to over three-quarters of the sample (76%), with STI-PrEP and condoms rated as less acceptable strategies. The level of willingness to use doxy-PEP we found was similar to earlier studies conducted in North America (range, 60%–84%).<sup>17,19,20</sup> Our results support previous findings that interest in STI-PrEP (taking daily antibiotics to prevent STIs) is generally lower than interest in taking 1 to 2 pills after sex,<sup>17–19</sup> underscoring the attraction of a less intensive dosing strategy like doxy-PEP.

Nearly 8% of our participants had previously used antibiotics for STI prevention (generally prescribed by a doctor), and 3% were currently using antibiotics for STI prevention, with most of these participants indicating they were practicing STI-PEP. This is the first national estimate of the use of antibiotics for STI prevention by GBM and nonbinary people in Australia. We found a higher level of antibiotic use for STI prevention among PrEP users and people living with HIV (10%–11%), similar to that found in an Australian study conducted in 2018.<sup>22</sup> Among the minority of participants who had used antibiotics for STI prevention, over a third had reused antibiotics that had been prescribed for other purposes. It is not clear whether these repurposed antibiotics consisted of doxycycline or another antibiotic. The Australian consensus statement on doxy-PEP advises against the use of antibiotics other than doxycycline, as these have not been studied for STI prevention effectiveness or their effect on AMR.<sup>16</sup> This could be addressed in community education about the effective use of doxy-PEP.

The World Health Organization has identified AMR as a global public health threat, reducing the efficacy of antibiotics

**TABLE 1.** Participant Characteristics and Factors Associated With Acceptability of Doxy-PEP

	Acceptability of Doxy-PEP			OR (95% CI)	P	AOR (95% CI)	P
	All Participants (N = 2046), n (%)	Not Acceptable/Neutral (n = 496), n (%)	Acceptable (n = 1550), n (%)				
Median age (interquartile range), y	35.0 (27.0–46.0)	36.0 (28.0–45.0)	35.0 (27.0–46.0)	1.00 (0.99–1.01)	0.951		
Sexual identity							
Gay	1672 (81.7)	413 (83.3)	1259 (81.2)	Ref			
Bi/queer/other	374 (18.3)	83 (16.7)	291 (18.8)	1.15 (0.88–1.50)	0.306		
State/territory							
New South Wales	663 (32.4)	165 (33.3)	498 (32.1)	Ref			
Victoria	568 (27.8)	136 (27.4)	432 (27.9)	1.05 (0.81–1.37)	0.701		
Queensland	380 (18.6)	91 (18.3)	289 (18.6)	1.05 (0.78–1.41)	0.734		
Other	435 (21.3)	104 (21.0)	331 (21.4)	1.05 (0.80–1.40)	0.712		
Region of birth							
Australia	1430 (69.9)	351 (70.8)	1079 (69.6)	Ref			
Asia	275 (13.4)	65 (13.1)	210 (13.5)	1.05 (0.78–1.42)	0.748		
Europe	160 (7.8)	37 (7.5)	123 (7.9)	1.08 (0.73–1.59)	0.692		
Other	181 (8.8)	43 (8.7)	138 (8.9)	1.04 (0.73–1.50)	0.816		
Aboriginal and/or Torres Strait Islander							
No	2001 (97.8)	486 (98.0)	1515 (97.7)	Ref			
Yes	45 (2.2)	10 (2.0)	35 (2.3)	1.12 (0.55–2.28)	0.749		
Education level							
High school/trade certificate	737 (36.0)	159 (32.1)	578 (37.3)	Ref		Ref	
University degree	1309 (64.0)	337 (67.9)	972 (62.7)	0.79 (0.64–0.98)	0.035	0.92 (0.73–1.16)	0.503
Employment status							
Employed full-time	1391 (68.0)	332 (66.9)	1059 (68.3)	Ref			
Employed part-time	369 (18.0)	95 (19.2)	274 (17.7)	0.90 (0.69–1.18)	0.455		
Student/unemployed/other	286 (14.0)	69 (13.9)	217 (14.0)	0.99 (0.73–1.33)	0.926		
Annual income							
<\$40,000	343 (16.8)	86 (17.3)	257 (16.6)	Ref			
≥\$40,000	1703 (83.2)	410 (82.7)	1293 (83.4)	1.06 (0.81–1.38)	0.694		
Medicare cover							
No	192 (9.4)	41 (8.3)	151 (9.7)	Ref			
Yes	1854 (90.6)	455 (91.7)	1399 (90.3)	0.83 (0.58–1.20)	0.327		
HIV status and PrEP use							
Untested/unknown status	196 (9.6)	37 (7.5)	159 (10.3)	1.67 (1.13–2.47)	0.01	1.49 (0.99–2.24)	0.059
HIV negative not on PrEP	764 (37.3)	214 (43.1)	550 (35.5)	Ref		Ref	
HIV negative on PrEP	947 (46.3)	207 (41.7)	740 (47.7)	1.39 (1.12–1.73)	0.003	1.29 (0.99–1.68)	0.06
HIV positive	139 (6.8)	38 (7.7)	101 (6.5)	1.03 (0.69–1.55)	0.871	0.88 (0.57–1.35)	0.55
Time since last HIV test							
≤12 mo	1476 (72.1)	353 (71.2)	1123 (72.5)	Ref			
>12 mo	379 (18.5)	107 (21.6)	272 (17.5)	0.80 (0.62–1.03)	0.083		
Never tested for HIV	191 (9.3)	36 (7.3)	155 (10.0)	1.35 (0.92–1.98)	0.12		
Time since last test for STIs							
≤12 mo	1444 (70.6)	361 (72.8)	1083 (69.9)	Ref			
>12 mo	317 (15.5)	74 (14.9)	243 (15.7)	1.09 (0.82–1.46)	0.536		
Never tested for STIs	285 (13.9)	61 (12.3)	224 (14.5)	1.22 (0.90–1.66)	0.197		
STI diagnosis (last 12 mo)							
No	1496 (73.1)	376 (75.8)	1120 (72.3)	Ref			
Yes	550 (26.9)	120 (24.2)	430 (27.7)	1.20 (0.95–1.52)	0.121		
Prior use of antibiotics to prevent STIs							
No	1892 (92.5)	480 (96.8)	1412 (91.1)	Ref		Ref	
Yes	154 (7.5)	16 (3.2)	138 (8.9)	2.93 (1.73–4.97)	<0.001	3.09 (1.78–5.35)	<0.001
Knowledge of AMR							
Nothing	775 (37.9)	144 (29.0)	631 (40.7)	Ref		Ref	
A little/moderate amount	816 (39.9)	206 (41.5)	610 (39.4)	0.68 (0.53–0.86)	0.001	1.04 (0.73–1.48)	0.832
A lot/great deal	455 (22.2)	146 (29.4)	309 (19.9)	0.48 (0.37–0.63)	<0.001	0.83 (0.54–1.28)	0.404
Concern about AMR							
No knowledge of AMR/unconcerned/neutral	1078 (52.7)	195 (39.3)	883 (57.0)	Ref		Ref	
Concerned/very concerned	968 (47.3)	301 (60.7)	667 (43.0)	0.49 (0.40–0.60)	<0.001	0.51 (0.36–0.72)	<0.001

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TABLE 1. (Continued)

	All Participants (N = 2046), n (%)	Acceptability of Doxy-PEP		OR (95% CI)	P	AOR (95% CI)	P
		Not Acceptable/Neutral (n = 496), n (%)	Acceptable (n = 1550), n (%)				
No. of male partners in last 6 mo							
None	231 (11.3)	54 (10.9)	177 (11.4)	Ref			
1–5	961 (47.0)	259 (52.2)	702 (45.3)	0.83 (0.59–1.16)	0.268		
6–10	365 (17.8)	74 (14.9)	291 (18.8)	1.20 (0.81–1.79)	0.369		
>10	489 (23.9)	109 (22.0)	380 (24.5)	1.06 (0.73–1.54)	0.745		
Sex with regular male partners in last 6 mo							
No regular male partner(s) or no anal sex	696 (34.0)	173 (34.9)	523 (33.7)	Ref			
Consistent condom use	117 (5.7)	36 (7.3)	81 (5.2)	0.74 (0.48–1.14)	0.177		
Any condomless sex	1233 (60.3)	287 (57.9)	946 (61.0)	1.09 (0.88–1.35)	0.434		
Sex with casual male partners in last 6 mo							
No casual male partner(s) or no anal sex	669 (32.7)	183 (36.9)	486 (31.4)	Ref			
Consistent condom use	197 (9.6)	53 (10.7)	144 (9.3)	1.02 (0.72–1.46)	0.901	1.01 (0.70–1.44)	0.967
Any condomless sex	1180 (57.7)	260 (52.4)	920 (59.4)	1.33 (1.07–1.66)	0.01	1.16 (0.89–1.52)	0.267
Drug use for sex (“chemsex”) in last 6 mo							
No	1717 (83.9)	414 (83.5)	1303 (84.1)	Ref			
Yes	329 (16.1)	82 (16.5)	247 (15.9)	0.96 (0.73–1.26)	0.753		

and making infections harder to treat.<sup>23</sup> More than one-third of our sample indicated that they knew nothing about AMR, but most participants who knew something about AMR were concerned about it. We do not believe that knowledge of AMR has been assessed among Australian GBM and nonbinary people before. Public campaigns have been conducted in Australia since the 2000s to raise awareness of AMR and reduce antibiotic overprescribing.<sup>24,25</sup> Comparative research suggests that, although most Australians (82%) are aware that overuse of antibiotics can reduce their effectiveness, they are more likely than British and Swedish peers to use antibiotics and retain leftover prescriptions.<sup>24</sup> We found that poorer knowledge of AMR was associated with sociodemographic factors such as older age, being born in Asia, a lower education level, and lack of access to Medicare (the latter suggestive of recent migration to Australia). HIV-negative participants not on PrEP knew less about AMR than PrEP users. It is unclear why older participants knew less about AMR than younger participants, but it is possible that younger participants had been more exposed to public campaigns about AMR, as some campaign materials were specifically developed for children and schools.<sup>25</sup> Overuse and misuse of antibiotics have been recognized as a common problem in the Asia Pacific region.<sup>26</sup> These results suggest opportunities to increase knowledge of AMR as part of community education about doxy-PEP, including culturally relevant resources developed with migrants from Asia.<sup>26</sup>

Similar to earlier studies, at a bivariable level, we found that interest in using doxy-PEP was higher among PrEP users and participants who had had condomless sex with casual partners.<sup>17,20</sup> However, in contrast to these studies, we did not find that recent STI diagnoses were associated with interest in using doxy-PEP, and in our multivariable analysis, only prior use of antibiotics for STI prevention and concerns about AMR were independently associated with interest in doxy-PEP. That there were few factors that differentiated interest in doxy-PEP is perhaps not surprising, given the high overall level of interest in doxy-PEP in the sample (76%), and relatively high levels of PrEP use (46%), condomless sex with casual partners (58%), and recent STI diagnoses (27%); that is, there was broad interest in doxy-PEP in a sample that reported relatively high levels of risk for STIs and a high level of recent diagnoses. It is possible that raising awareness of AMR might reduce the level of interest in doxy-PEP, if people became (more)

concerned about AMR. We support educating community members about AMR in relation to doxy-PEP without unnecessarily scaring them, given that recent research suggests that doxy-PEP reduces the risk of STIs, but there are insufficient current data about its effect on AMR.<sup>14</sup>

The high level of interest we and others have found in doxy-PEP suggests that many GBM and nonbinary people would try using it, if they were offered it by a clinician. This could assist in preventing many future STIs. However, we note that the prescribing scenarios suggested in consensus statements, guidelines, and modeling suggest restricting doxy-PEP to subgroups of gay and bisexual men and trans women, to maximize efficiency (the lowest number needed to treat to avert STIs) and minimize risks such as AMR and side effects. The subgroups and scenarios suggested include people who have been recently diagnosed with syphilis or more than one STI in the previous year, patients who are using HIV PrEP, or those who will remain at higher risk of STIs in the immediate future due to their recent or anticipated level of sexual activity.<sup>16,27–29</sup> Most of these scenarios suggest that a minority of gay and bisexual men and other people would be eligible for doxy-PEP (if clinical recommendations were applied), which creates a potential mismatch between community interest in doxy-PEP and public health or clinical aims to target its use. This suggests that community (and professional) education about doxy-PEP should discuss its potential risks and benefits, and recommended scenarios for its use (i.e., proposed eligibility criteria). This educational material should be revised as further knowledge is gained of doxy-PEP's effects on AMR.

Our study findings are limited by the cross-sectional design and convenience sampling, which is likely to have underrepresented some GBM, particularly bisexual men and participants from regional areas.<sup>30</sup> There are currently no representative studies of transgender men and nonbinary people in Australia, so we cannot comment on whether they are over- or under-represented. We used single-item measures of the acceptability of different STI prevention strategies, knowledge, and concern about AMR, and did not ascertain what participants knew about AMR or the focus of their concerns. The majority of the sample had not used antibiotics for STI prevention, so we were primarily assessing the hypothetical willingness to use doxy-PEP (and doxy-PrEP). The level of interest we found may not translate into actual levels of use. We





- prophylactic use of doxycycline against *Chlamydia trachomatis* infections and syphilis. *Sex Transm Dis* 2021; 48:615–619.
18. Arapali T, Grulich AE, Heywood AE, et al. Factors associated with willingness to use daily antibiotics as sexually transmitted infection prophylaxis among HIV preexposure prophylaxis-experienced gay and bisexual men in Australia. *Sex Transm Dis* 2023; 50:144–149.
  19. Fusca L, Hull M, Ross P, et al. High interest in syphilis pre-exposure and post-exposure prophylaxis among gay, bisexual and other men who have sex with men in Vancouver and Toronto. *Sex Transm Dis* 2020; 47:224–231.
  20. Spinelli MA, Scott HM, Vittinghoff E, et al. High interest in doxycycline for sexually transmitted infection postexposure prophylaxis in a multicity survey of men who have sex with men using a social networking application. *Sex Transm Dis* 2019; 46:e32–e34.
  21. MacGibbon J, Yu S, Broady T, et al. Evolving Attitudes to Biomedical HIV Prevention Among Gay, Bisexual and Queer Men and Non-Binary People: Key Findings From the PrEPARE Project 2023. Sydney: Centre for Social Research in Health, UNSW Sydney, 2024.
  22. Chow EPF, Fairley CK. Use of doxycycline prophylaxis among gay and bisexual men in Melbourne. *Lancet HIV* 2019; 6:e568–e569.
  23. World Health Organization. Antimicrobial Resistance. Geneva, Switzerland: World Health Organization, 2023.
  24. Hawkins O, Scott AM, Montgomery A, et al. Comparing public attitudes, knowledge, beliefs and behaviours towards antibiotics and antimicrobial resistance in Australia, United Kingdom, and Sweden (2010–2021): A systematic review, meta-analysis, and comparative policy analysis. *PLoS One* 2022; 17:e0261917.
  25. Weekes L, Mackson J, Wutzke S. An ongoing national programme to reduce antibiotic prescription and use. *Microbiol Aust* 2007; 28: 201–204.
  26. Yam ELY, Hsu LY, Yap EP, et al. Antimicrobial resistance in the Asia Pacific region: A meeting report. *Antimicrob Resist Infect Control* 2019; 8:202.
  27. Werner RN, Schmidt AJ, Potthoff A, et al. Position statement of the German STI Society on the prophylactic use of doxycycline to prevent STIs (doxy-PEP, doxy-PrEP). *J Dtsch Dermatol Ges* 2024; 22:466–478. Advance online publication.
  28. Traeger MW, Mayer KH, Krakower DS, et al. Potential impact of doxycycline post-exposure prophylaxis prescribing strategies on incidence of bacterial sexually transmitted infections. *Clin Infect Dis* 2023; ciad488.
  29. DiMarco D, Urban M, Fine S, et al. Doxycycline Post-Exposure Prophylaxis to Prevent Bacterial Sexually Transmitted Infections. Baltimore, MD: Johns Hopkins University Clinical Guidelines Program, 2023.
  30. Grulich AE, de Visser RO, Badcock PB, et al. Homosexual experience and recent homosexual encounters: The 2nd Australian Study of Health and Relationships. *Sex Health* 2014; 11:439–450.