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Duration of gargling and rinsing among frequent mouthwash users: a cross-sectional study

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ABSTRACT

Objective To examine the rinsing and gargling mouthwash practices among frequent mouthwash users to determine if there are differences in use between gender, sexual orientation and sex work status.

Design Cross-sectional study.

Setting Data obtained from patients attending a sexual health centre located in Melbourne, Australia.

Participants 200 frequent mouthwash users (four or more times per week), 50 for each of the following patient groups: men who have sex with men (MSM), female sex workers (FSW), females who are not sex workers and men who have sex with women only (MSW). Participants were observed and audio recorded using mouthwash.

Primary and secondary outcome measures Descriptive analyses were conducted to calculate the median age, time rinsing and gargling, amount of mouthwash used and proportion of participants who rinsed, gargled or both, as determined from the audio files. Kruskal-Wallis H test and χ^2 test were used to examine differences between the patient groups.

Results Median age was 28 years (IQR: 24–33). During the study, most (n=127; 63.5%) rinsed and gargled, but 70 (35.0%) rinsed only and three (1.5%) gargled only. Median time rinsing was 13.5 s (IQR: 8.5–22.0 s), gargling was 4.0 s (IQR: 2.5–6.0 s) and the median total duration was 17.0 s (IQR: 11.5–25.8 s). Median duration of mouthwash did not differ significantly between the groups (females not sex workers: 18.8 s (IQR: 12.5–24.5 s); FSW: 14.0 s (9.0–22.0 s); MSM: 22.3 s (13.0–26.5 s); MSW: 15.8 s (12.0–25.0 s); p=0.070) but males used mouthwash longer than females (median 20.3 s compared with 15.5 s; p=0.034). The median volume of mouthwash used was 20 mL (IQR: 15–27 mL). And most (n=198; 99.0%) did not dilute mouthwash with water.

Conclusion Over a quarter of frequent users do not gargle mouthwash at all (35%) and used it for a substantially shorter period of time than it was used in the randomised trial (1 min) where it was shown to be effective at inhibiting *Neisseria gonorrhoeae* growth. Our findings suggest that many frequent mouthwash users do not follow the manufacturer instructions for using mouthwash and may not use mouthwash in a way that was shown to reduce the growth of oropharyngeal gonorrhoea.

Strengths and limitations of this study

- ► This is the first study examining duration of rinsing and gargling mouthwash among frequent mouthwash users who are sexually active.
- ► Our data was collected from a sexual health clinic and thus includes four key patient demographics at risk of sexually transmitted infections.
- ► Our data includes self-reported and actual mouthwash duration.
- ► This data does not include method of mouthwash use for infrequent mouthwash users, which may have a longer or shorter duration.

INTRODUCTION

The prevalence and incidence of gonorrhoea have increased substantially over the last decade, particularly among gay, bisexual and other men who have sex with men (MSM) in Australia and globally,[1–4] with MSM not living with HIV in Australia having a 34.0% increase in gonorrhoea diagnoses between 2013 and 2017 (21.9 per 100 person-years in 2017, vs 16.4 in 2013).[5] A rise in gonorrhoea has also been observed in other populations such as heterosexuals[5–7] and female sex workers (FSW), with heterosexual males in Melbourne, Australia, having an increase in gonorrhoea incidence from 0.72% in 2007 to 1.33% in 2017[7] and FSW having a 47.0% increase in gonorrhoea incidence (from 3.6 to 5.3 per 100 person-years) in Australia between 2013 and 2017.[5 8 9] No gonorrhoea prevalence data is available specifically for heterosexual females in Australia who are not sex workers, to our knowledge, however females in Australia had a 56.1% increase in gonorrhoea diagnoses between 2013 and 2017 (39.6 per 10 000 females in 2013 vs 61.8 per 100 000 females in 2017).[5] Previous studies have suggested that the oropharynx may be an important site for gonorrhoea transmission, with gonorrhoea spreading

from the oropharynx through tongue kissing, rimming and using saliva as lubricant during anal sex.[10–16]

With the rise of antimicrobial resistance in *Neisseria gonorrhoeae*,[17 18] antiseptic mouthwash has been proposed as a novel intervention to prevent oropharyngeal gonorrhoea infection.[11] A small randomised controlled trial and in vitro study published in 2017 suggested that the single use of mouthwash may inhibit the growth of *N. gonorrhoeae* in the oropharynx[19] and past qualitative and quantitative studies have shown that mouthwash use would be a highly acceptable intervention for gonorrhoea prevention, should it be recommended.[20 21]

N. gonorrhoeae can be cultured from the posterior oropharyngeal wall and the tonsillar fossae,[22] and it will be important for mouthwash to reach both sites to prevent oropharyngeal gonorrhoea if it is found to be effective. We have published a study in 2019 that highlighted the anatomical sites reached by rinsing, gargling and using a mouthwash spray, the results of which indicated that rinsing alone for 15 s was less effective at reaching the posterior pharyngeal wall than gargling for 15 s, while using a spray was most effective and had the highest overall coverage.[23] The randomised controlled trial that found mouthwash use was effective at reducing the detection of *N. gonorrhoeae* by culture had participants use mouthwash for 60 s, including gargling for a substantial period of time.[19] The effectiveness of mouthwash in preventing oropharyngeal gonorrhoea may depend in part on the ability of mouthwash to reach all reservoirs of infection and the duration of use.[24] However, there have been limited studies examining how people use mouthwash in their routine practice. If mouthwash is found to be effective in preventing gonorrhoea, it can be translated into a public health intervention. Understanding how individuals use mouthwash could help in designing future public health interventions. Past Australian studies have reported that 74% of FSW use mouthwash routinely in their workplace[25] and 53% of MSM use mouthwash daily or weekly.[26] Another study of mouthwash use in the general population reported 39% of Australians used mouthwash within the last 7 days,[27] however, no study to our knowledge specifically reported the proportion of mouthwash use by gender and sexual orientation. We hypothesised that the use of mouthwash may vary across different risk groups in relation to the exposure of sexual risk. Furthermore, there has been no observational study examining how individuals actually use mouthwash, including the volume of mouthwash, method and duration of mouthwash use.

The aim of this study was to examine mouthwash practices among frequent (four times or more per week) mouthwash users in order to understand the method and duration of mouthwash use and to determine if there were any differences in mouthwash use between four different patient populations attending a sexual health centre.

MATERIALS AND METHODS

Study population and setting

The 'Gargle, Rinse A Mouthwash' (GRAM) study was a cross-sectional study conducted at the Melbourne Sexual Health Centre (MSHC) between August 2017 and January 2019. MSHC is the largest public sexual health centre located in the State of Victoria, Australia, providing approximately 50 000 consultations a year. Fifty participants were recruited from four patient groups based on their gender and sexual practices: MSM, men who have sex with women only (MSW), FSW) and females who were not sex workers. Recruitment target was 50 participants in each group, for a total of 200 participants, in order to provide an adequate sample for 95% CIs. Individuals who were aged 16 years or older and self-reported using mouthwash four times or more per week were eligible for the study. Transgender individuals were excluded from the study due to small population size attending clinic compared with the other patient groups and time constraints for study recruitment.[28] Those self-reporting an allergy to certain mouthwash components were also excluded.

The first phase of recruitment was by clinician referral from 1 August 2017 to 19 August 2018. During the second phase of recruitment, from 20 August 2018 to 15 January 2019, clients were able to express interest and eligibility in the study using a computer-assisted self-interview (CASI), which all clients are invited to complete as part of routine clinical care and management on arrival. During phase two, an additional question was asked on CASI about the frequency of mouthwash use and interest in participating in the study. An automated email was generated and sent to the research study team when a client self-reported using mouthwash 4 days or more per week and expressed interest in participating in the study. A member of the research study team then met with the client to obtain informed written consent.

Patient and public involvement

Patients were not involved in the design, conduct, reporting or dissemination of our research study.

Mouthwash use

Participants were instructed to choose one from 12 study mouthwash products that are freely available in Australian supermarkets: Listerine Freshburst, Listerine Total Care, Listerine Zero, Listerine Gold, Colgate Plax, Colgate Total, Coles brand Mint Fresh, Woolworths brand Total Care All Smiles, Oral-B Pro-Health, Oral-B 3D White, Sensodyne and Biotene. Coles and Woolworths are two supermarket chains in Australia.

Participants were advised to select the mouthwash they normally use if it was available, otherwise to pick one they thought would be the most similar. A 70 mL yellow-cap specimen jar (Sarstedt Australia Pty; Mawson Lakes, South Australia, Australia) was provided for participants to pour in the amount of mouthwash they normally use. The total amount of mouthwash poured was recorded by the

research nurse (KM, RW). Participants were asked to use the study mouthwash as they normally would use mouthwash in their routine practice; no further instruction was given to participants on how to use the study mouthwash. Each participant was observed and audio recorded while they used the mouthwash.

Questionnaire data before and after mouthwash use

Participants were asked to complete a short questionnaire on their current mouthwash use before selecting and using a study mouthwash. The questionnaire asked participants to report: the brand of mouthwash they typically use; whether they rinsed, gargled or both; how long they usually had the mouthwash in their mouth; whether or not they rinsed with water after using mouthwash; and if they usually drink or eat within 30 min after using mouthwash.

After using the study mouthwash, participants were asked to record any differences in the study mouthwash compared with how they use mouthwash in their routine practice. They were also asked if the mouthwash used was frothy (ie, creating lots of bubbles while using it) or uncomfortable.

Audio files

Each audio file was listened to by one member of the research team (ST) who recorded the sequence of mouthwash activity (rinse or gargle) for each participant, and the duration (in seconds) of each activity. A second researcher (KM) was blinded to the initial assessment and reassessed all participant audio files. The two assessments were averaged for total rinse, gargle and mouthwash duration.

Statistical analysis

Descriptive analyses were conducted to calculate the median age of participants, median time rinsing and gargling, median amount of mouthwash used and proportion of participants who rinsed, gargled or both, as determined from the audio files. The concordance correlation coefficient (rho_c) was calculated for the total rinse, gargle and mouthwash duration between the two independent assessments.

Kruskal-Wallis H test was used to compare the difference in age, total duration of mouthwash use and how often the participants drink or rinse after using mouthwash between the four patient groups. Bonferroni correction was used to identify which two of the four groups differed significantly for those with a significant p value of <0.05 from the Kruskal-Wallis H test. A χ^2 test was used to examine the differences between the four patient groups and mouthwash brand used, method of mouthwash use (gargle, rinse or both), whether or not participants diluted the mouthwash, rinsed after using or felt discomfort after using. Paired t-test was used to show the difference in participant's reported mouthwash use duration and the duration of their mouthwash use during the study. Mann-Whitney U test was used to compare total duration between men and women and between those who found the mouthwash frothy and those who did not.

All statistical analyses were performed using Stata (V.14, Stata Corporation).

RESULTS

During the first, clinician-led, phase of recruitment, 60 clients were referred to the study team, of whom seven were ineligible (11.7%) because they used mouthwash less than four times per week. During the second phase of recruitment when participants were able to self-report eligibility and interest in the study on CASI, 153 clients were contacted by the study team. Of these 153 clients, six (3.9%) were ineligible because they either used mouthwash less than four times per week (n=3), declined without any reason after the research nurse explained the study (n=2) or declined to participate because they felt 'overwhelmed' after their clinical consult (n=1).

A total of 200 participants were recruited and the median age was 28 years (IQR: 24–33). The median ages for each patient group are presented in table 1, and there was a significant difference in median age between the groups with MSM significantly older than females who were not sex workers (p<0.001).

There was a discrepancy in mouthwash duration between the two researcher's audio assessments greater than 5 s (s) in n=4 files (2.0%). The concordance correlation coefficient (rho_c) between the initial two assessments was 0.989 (p<0.001) for rinsing duration, 0.973 (p<0.001) for gargle duration and 0.989 (p<0.001) for total duration.

More than half of the participants (n=127; 63.5%) both rinsed and gargled the study mouthwash, but 70 (35.0%) rinsed only and 3 (1.5%) gargled only. The median time for rinsing among all participants who rinsed was 13.5 s (IQR: 8.5–22.0 s) and this did not differ across the four patient groups (p=0.086) (table 1). The median time for gargling among 130 participants who gargled was 4.0 s (IQR: 2.5–6.0 s) and this did not differ across the four patient groups (p=0.154) (table 1).

The median total duration of mouthwash use among all 200 participants was 17.0 s (IQR: 11.5–25.8 s) and there was no difference between the median total duration across the four patient groups (p=0.070) (figure 1A). Men had a longer duration of total mouthwash use compared with women (median 20.3 vs 15.5 s; p=0.034) (figure 1B). Participants self-reported mean duration of mouthwash use was significantly shorter than the actual mean duration of mouthwash use in the study (20.0 vs 25.0 s; p<0.001).

Median total volume of mouthwash used among all participants was 20 mL (IQR: 15–27 mL) (table 1).

Most (n=198; 99.0%) did not dilute mouthwash with water.

Most participants had a shorter mouthwash duration than was recommended by the mouthwash manufacturer for the study mouthwash they chose (n=169; 84.5% used

Table 1 Participant demographics and mouthwash practice for each patient group

	Females who were not sex workers n=50	Female sex workers n=50	Men who have sex with men n=50	Men who have sex with women only n=50	P value
Median age in years (IQR)	26 (23–28)	28 (23–34)	32 (26–44)	29 (26–33)	<0.001*
Self-reported mouthwash use in routine practice†					
Mouthwash brand most frequently used by participants‡, n (%)	Listerine, 27 (54.0)	Listerine, 34 (68.0)	Listerine, 32 (64.0)	Listerine, 38 (76.0)	0.079
Method of using mouthwash, n (%)					0.168
Rinse only	20 (40.0)	12 (24.0)	12 (24.0)	12 (24.0)	
Gargle only	2 (4.0)	0	1 (2.0)	0	
Both rinse and gargle	28 (56.0)	38 (76.0)	37 (74.0)	38 (76.0)	
Duration of mouthwash use in seconds, median (IQR)	20 (10–30)	13 (8–30)	30 (15–30)	20 (10–30)	0.008§
Drink or eat within 30 min, n (%)					0.361
Always/often	4 (8.0)	4 (8.0)	6 (12.0)	6 (12.0)	
Sometimes	22 (44.0)	27 (54.0)	10 (20.0)	20 (40.0)	
Almost never/never	23 (46.0)	12 (24.0)	18 (36.0)	22 (44.0)	
Missing/did not report	1 (2.0)	7 (14.0)	16 (32.0)	2 (4.0)	
Rinse with water after using, n (%)					0.989
Always/often	11 (22.0)	7 (14.0)	9 (18.0)	9 (18.0)	
Sometimes	9 (18.0)	10 (20.0)	4 (8.0)	11 (22.0)	
Almost never/never	29 (58.0)	26 (52.0)	21 (42.0)	28 (56.0)	
Missing/did not report	1 (2.0)	7 (14.0)	16 (32.0)	2 (4.0)	
Mouthwash use during the GRAM study					
Mouthwash brand most frequently used in the study¶, n (%)	Listerine, 28 (56.0)	Listerine, 29 (58.0)	Listerine, 31 (62.0)	Listerine, 36 (72.0)	0.132
Method of using mouthwash, n (%)					0.502
Rinse only	23 (46.0)	15 (30.0)	13 (26.0)	18 (36.0)	
Gargle only	1 (2.0)	1 (2.0)	1 (2.0)	0	
Rinse and gargle	26 (52.0)	34 (68.0)	36 (72.0)	32 (64.0)	
Median time rinsing in seconds (IQR)	15.5 (9.0–22.0)	11.0 (7.0–19.0)	18.0 (11.0–24.5)	12.5 (9.0–22.0)	0.086
Median time gargling in seconds (IQR)	3.5 (2.5–6.0)	4.0 (3.5–5.5)	4.5 (2.0–7.0)	3.0 (2.5–6.5)	0.154
Median total duration of mouthwash in seconds (IQR)	18.8 (12.5–24.5)	14.0 (9.0–22.0)	22.3 (13.0–26.5)	15.8 (12.0–25.0)	0.07
Median volume mouthwash used in mL (IQR)	20.0 (15.0–20.0)	20.0 (15.0–20.0)	22.5 (20.0–30.0)	20.0 (20.0–28.0)	0.020**
Dilute with water, n (%)	0	1 (2.0)	1 (2.0)	0	0.568
Rinse with water right after using the study mouthwash, n (%)	11 (22.0)	8 (16.0)	8 (16.0)	8 (16.0)	0.921
Had any discomfort when using the mouthwash, n (%)	10 (20.0)	12 (24.0)	5 (10.0)	11 (22.0)	0.286

*Females who were not sex workers were significantly younger than men who have sex with men (p<0.001).
†As reported in the questionnaire given before participant used the study mouthwash.
‡Participant reported mouthwash brand they normally use; only the most frequently used reported here for each group.
§Bonferonni correction showed no significant difference between any two of the four groups for reported duration in routine use.
¶Participants were advised to select the mouthwash they normally use if it was available, otherwise to pick one they thought would be the most similar. See table 2 for full list of mouthwash brands used during the study.
**Females who were not sex workers used significantly less mouthwash than men who have sex with men (p=0.035).
GRAM, Gargle, Rinse A Mouthwash.

mouthwash for less time; table 2); 31 (15.5%) participants used the mouthwash for the same or longer time recommended by the manufacturer. Most participants (n=142; 71.0%) used the same amount or more recommended by the manufacturer; 58 (29.0%) used less than the recommended amount. There were six participants for whom the type of mouthwash used during the study was not recorded and they were excluded from comparisons to manufacturer's recommendations. There were no significant differences in the duration of rinsing (p=0.260), gargling (p=0.965) or total duration of use (p=0.460) by brand of mouthwash used.

Most (n=163; 81.5%) participants selected the same brand of mouthwash during the study as the brand they

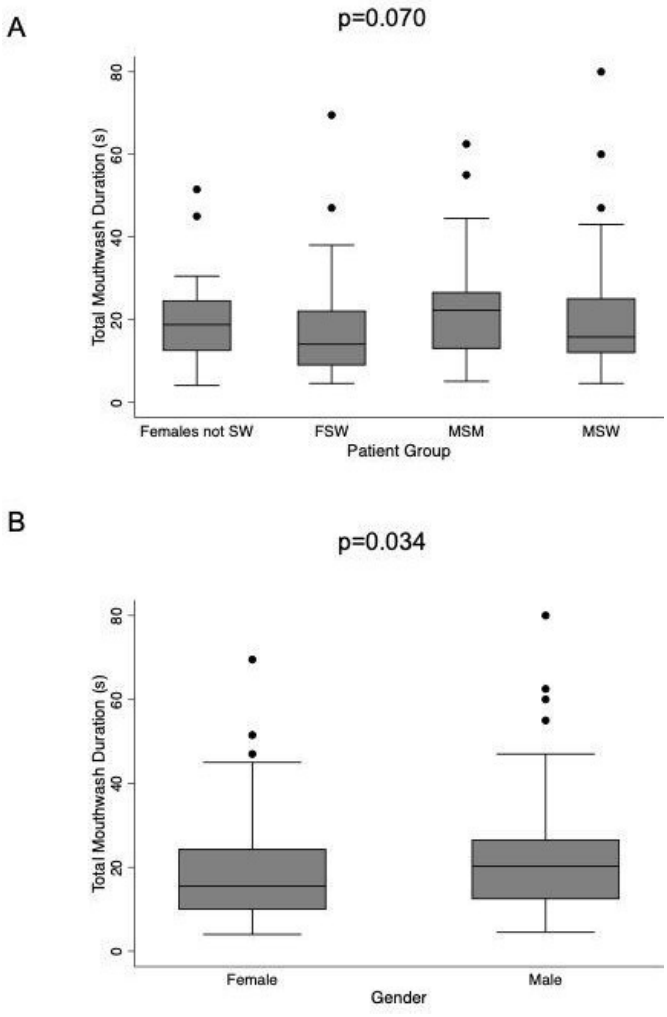

Figure 1 Median total mouthwash duration by (A) patient group and (B) gender. FSW, female sex worker; MSM, men who have sex with men only; MSW, men who have sex with women only; SW, sex worker.

reported using in their routine practice and most (n=174; 87.0%) participants stated no difference in how they used the study mouthwash compared with how they used it at home. Of the self-reported differences, the two most common differences were that they used a larger amount of mouthwash (n=6; 3.0%) than they normally would in their routine practice, and they used mouthwash for less time (n=6; 3.0%) than they normally would. There was one additional participant (0.5%) who said they used mouthwash for a shorter duration during the study due to using more mouthwash than they usually do, but the others who claimed the study duration was shorter did not provide a reason. Almost half of the participants found the mouthwash they used in the study to be frothy (creating lots of bubbles) (n=90/199; 45.2%). However, only two participants (1.0%) reported more froth as a difference in the study mouthwash compared with their mouthwash use in their normal routine. Participants who found the mouthwash frothy used mouthwash for a longer duration than those who did not (20.8 vs 14.0 s; p=0.003).

DISCUSSION

This is the first study to examine mouthwash practices among sexually active men and women in a sexual health clinic setting. We found that most (84.5%) participants used mouthwash for less than the time recommended by the manufacturer (30–60 s), by a factor of about twofold. We also found that a substantial proportion of participants in all patient groups (26.0%–46.0%) did not gargle at all, which is perhaps unsurprising given that only 4 out of the 12 mouthwashes used in the study recommend gargling. This is relevant as a previous study has shown that gargling is better than rinsing at reaching the posterior pharyngeal wall, which is a preferred site for *N. gonorrhoeae*.[23] Furthermore, a past randomised controlled trial found that mouthwash was effective at reducing the detection of *N. gonorrhoeae* by culture when it was used for 60s, including gargling for a substantial period of time.[19] If mouthwash was found to be effective in preventing oropharyngeal gonorrhoea, it is likely that educational programmes on the most effective use of mouthwash would be needed, particularly among those who are at risk of gonorrhoea.

Participants spent a median of 17.0 s using mouthwash. On average, participants spent more time rinsing (13.5 s) than gargling (4.0 s). None of the manufacturer recommendations for mouthwash brands used in this study stipulate a duration for gargling alone; however, previous research has shown that gargling for 30 s results in significantly more coverage of the oropharynx than 30 s of rinsing alone.[29] Similarly, another study showed 15 s of gargling was as effective as 15 s and even 60 s of rinsing in reaching the posterior pharyngeal wall and tonsils, two sites favoured by *N. gonorrhoeae*.[23] The results of our study suggest that regular mouthwash users may not be using mouthwash in a manner sufficient to reach the posterior oropharyngeal wall and the tonsillar fossae, given the large proportion who do not gargle and the short gargle duration among those who do.

Our finding that participants self-reported mean duration of mouthwash use was significantly shorter than their actual mouthwash use duration during the study suggests participants may have recall bias when estimating length of time or may even struggle to accurately estimate length of time while using mouthwash. This could be important information to note should future studies require participants to use mouthwash for a specified length of time unsupervised, as utilising a stopwatch may be beneficial.

It is unclear why participants in this study who described the mouthwash as frothy used the mouthwash for a significantly longer duration than those who did not. While we know of no studies examining the effect of froth on mouthwash use, it is possible participants were inclined to keep using the mouthwash for longer after they felt it start to bubble. Further qualitative studies should be conducted to examine frequent mouthwash users' attitudes toward frothiness.

There were several limitations in this study. First, participants were recruited from one sexual health clinic and

Table 2 Mouth brands used in the study, manufacturer recommendations for use and proportion of participants per patient group using each mouthwash during the study

Mouthwash used in the study*	Recommended method	Recommended duration in seconds†	Recommended volume in mL	n‡ (%) Females not SW used	n‡ (%) FSW used	n‡ (%) MSM used	n‡ (%) MSW used
Listerine Freshburst	Rinse	30	20	16/49 (32.7)	12/49 (24.5)	8/49 (16.3)	18/47 (38.3)
Listerine Total Care	Rinse	30	20	8/49 (16.3)	12/49 (24.5)	10/49 (20.4)	8/47 (17.0)
Colgate Plax Freshmint	Rinse and gargle	30	20	9/49 (18.4)	12/49 (24.5)	4/49 (8.2)	6/47 (12.8)
Listerine Zero	Rinse	30	20	2/49 (4.1)	4/49 (8.2)	10/49 (20.4)	8/47 (17.0)
Oral-B 3D White Luxe Diamond Strong	Rinse	60	10	4/49 (8.2)	0	4/49 (8.2)	0
Oral-B Pro-Health Clinical	Rinse	30	20	1/49 (2.0)	2/49 (4.1)	3/49 (6.1)	2/47 (4.3)
Listerine (Gold)	Rinse	30	20	2/49 (4.1)	1/49 (2.0)	3/49 (6.1)	2/47 (4.3)
Colgate Total Pro-Shield	Rinse and Gargle	30	20	3/49 (6.1)	0	2/49 (4.1)	2/47 (4.3)
Coles Mint Fresh	Rinse and gargle	30	20	2/49 (4.1)	3/49 (6.1)	1/49 (2.0)	0
Sensodyne Cool Mint	Rinse	60	10	2/49 (4.1)	3/49 (6.1)	1/49 (2.0)	0
Biotene Dry Mouth	Rinse	30	15	0	0	3/49 (6.1)	1/47 (2.1)
Woolworth brand Total Care All Smiles	Rinse and gargle	30	20	0	0	0	0

*Listed in order of most commonly used during the study overall.
†Recommended use/instructions for use supplied by the manufacturer as listed on the bottle.
‡There were n=6 participants for whom mouthwash brand used during the study was not recorded, therefore the total number in each patient group varies.
FSW, female sex worker; MSM, men who have sex with men; MSW, men who have sex with women; SW, sex worker.

thus results may not be generalisable to the wider population. However, this also represents a strength in the study, as participants at this site are at significant sexually transmitted infection (STI) risk and likely representative of the target population any mouthwash intervention would aim to reach. Second, there may be differences in how participants used the study mouthwash compared with their routine practice as they were observed by the research nurse during the study. However, we note that 87.0% of participants self-reported that they used the study mouthwash in the same way as they used it at home. Third, we only included frequent mouthwash users and we defined this as 4 or more days per week to avoid the bias of infrequent mouthwash users. However, there may be differences in how frequent and infrequent mouthwash users use mouthwash in terms of duration and method. Finally, we did not collect any data on participant's oral health, including any oral hygiene concerns. It is possible that people with oral health or hygiene concerns may rinse or gargle for longer.

Current investigations of the efficacy of mouthwash use as a means for gonorrhoea prevention are being conducted.[30 31] Our study suggests that most frequent users of mouthwash may not use mouthwash in a method conducive to reaching the posterior pharyngeal wall, which is a known reservoir of gonorrhoea infection.[22] It may follow that the average frequent mouthwash user would not benefit from mouthwash use as a prevention measure for gonorrhoea if following their normal method of mouthwash use; however, it is unknown if mouthwash reaching the posterior oropharyngeal wall is an adequate proxy for effectiveness. Studies have shown that mouthwash spray provides more coverage than rinsing and gargling[23 29] although currently few mouthwashes are sold in spray applications to our knowledge. Future studies could potentially determine if the method of mouthwash has a difference in the effectiveness of mouthwash at preventing gonorrhoea, including using a mouthwash spray. Additionally, given the complex and delicate balance of a 'normal' oral microbiome and its importance to overall health,[32–34] future research should ensure any recommended mouthwash use to prevent oral STIs did not have deleterious effects to the oral microbiome.

CONCLUSION

Over a quarter of frequent mouthwash users do not gargle mouthwash at all (35%). Most (84.5%) use mouthwash for less time than the manufacturer recommends and substantially less time than it was used in the randomised trial (1 min) where it was shown to be effective at inhibiting *N. gonorrhoeae* growth.

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Contributors TRP aided in recruitment, conducted the data analysis and wrote the first draft of the manuscript. EPFC and CF conceived and designed the study and aided in data interpretation. EPFC oversaw the study and provided statistical advice. TRP, CF, KM and EPFC designed the questionnaires. KM, RW and ST were involved

in study recruitment and data collection. ST entered the data and coded the audio files. KM was involved in data entry management and coded the audio files. CB, JSH and all authors were involved in data interpretation and revised the manuscript for intellectual content.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethical approval was obtained from the Alfred Hospital Ethics Committee, Melbourne, Australia (number 340/17).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available. All data relevant to the study are included in the article.

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