The impact of redesigned advance notification letters on intention to screen for bowel cancer: a randomised controlled experiment

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Abstract

Objectives: The aim of this study was to examine the impact of redesigned advance notification letters on screening intention and the moderating role of screening barriers/facilitators.

Methods: In an online survey, 562 Australians aged 50–74 years were randomised to view one of three letters: the current letter (control) or one of two redesigns with enhanced graphics and evidence-based messaging. Participants rated their screening intention before and after viewing, with screening barriers and facilitators also measured.

Results: The redesigned letters did not increase screening intention over the control [control vs. Redesign 1: the estimated effect of the predictors (*b*)=0.12, *p*=0.204; control vs. Redesign 2: *b*=0.07, *p*=0.471]. Higher self-efficacy (*b*=0.12, *p*<0.001), perceived benefits (*b*=0.12, p<0.001), lower autonomy concerns (*b*=-0.23, p<0.001), avoidance (*b*=-0.16, p=0.004), disgust (*b*=-0.12, p=0.011) and perceived difficulty (*b*=-0.02, p<0.001) moderated the letters' effect on intention for all letter versions.

Conclusions: Advance notification letters increase intention, with certain reactions (e.g. high self-efficacy and perceived benefits) enhancing this effect. Design and content changes may not improve impact beyond the letter's intrinsic effect.

Implications for Public Health: Multi-pronged approaches may better address individual barriers. Exploring digital formats may enhance advanced notification effects.

Key words: colorectal cancer screening, colorectal neoplasms, early detection, faecal occult blood test, prenotification

Introduction

Screening enhances early detection of bowel cancer, thereby reducing mortality.¹ In Australia, the National Bowel Cancer Screening Program (NBCSP) automatically distributes at-home bowel screening kits to those aged 50–74 years and invites those aged 45–49 years to request to a kit in order to participate.² Participants are 1.7 times more likely to detect bowel cancer early if present and less than half as likely to die from it compared to non-participants.³ Despite this, participation remains low, at about 40% in

2021–2022.⁴ Increasing screening uptake is essential to reducing the bowel cancer burden in Australia.

Various interventions to increase screening participation, such as general practitioner endorsement, reminders and simplified procedures, have been trialled globally.⁵ Advanced notification is one such intervention, in which eligible individuals receive information on bowel screening before the kit arrives. In the NBCSP, this notification is a letter mailed four to six weeks before the kit's arrival, briefly outlining the importance of screening and prompting recipients to

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expect their kit soon. Although cost-effective,⁶ the advanced notification shows only small to moderate effects on participation, around 4–7%,^{5,7} suggesting room for improvement.

Theory-informed interventions consistently demonstrate superior outcomes compared to atheoretical approaches.⁸ Therefore, it may be possible to enhance the effectiveness of advance notification letters through the integration of psychological theory and evidence. Many prior theories have been applied to conceptualise bowel cancer screening behaviour, such as the Transtheoretical Model of Behavior Change,⁹ the Health Belief Model⁹ and the Health Action Process Approach.¹⁰ These frameworks share the fundamental proportion that intention formation is a critical precursor to screening participation.^{10,15} The temporal positioning of advance notification letters, delivered weeks before arrival of the screening kit, aligns with the theoretical mechanisms of intention formation.¹¹ These letters may facilitate screening uptake by providing recipients an extended period for contemplation and development of an intention to screen. Therefore, modifying the advance notification letter content to target established determinants of screening intention represents a theoretically viable approach to enhancing their effectiveness.

Prior studies investigating the effectiveness of theory-informed modifications to bowel cancer screening invitation letters have yielded mixed results. Randomised controlled trials in Australia¹² and Canada¹³ demonstrated that letters incorporating elements from established frameworks—namely the transtheoretical model,¹⁴ Health Belief Model⁹ and Theory of Planned Behavior¹⁵—significantly increased actual screening participation compared to standard invitations. Conversely, studies examining the impact of the letters on intention to screen, such as those conducted in Italy¹⁶ and the United Kingdom¹⁷ found that letters targeting common psychological barriers to screening, such as disgust and fear, failed to increase screening intention. Therefore, the optimal application of psychological theory to enhance screening intention through advance notification letters remains unclear.

Many factors affect screening intention.^{18–20} Facilitators like risk perception, self-efficacy (confidence in completing screening) and anticipating personal benefit from screening are linked to higher intention.²¹ Conversely, anticipating negative outcomes (such as inconvenience or learning of a cancer diagnosis; Myers et al., 2022), avoidance tendencies, and perceptions of screening as disgusting, difficult, or autonomy-violating reduce intention and can be referred to as barriers.²² It may therefore be possible to enhance the effect of an advance notification letter on screening intention using messaging, targeting these known facilitators and alleviating common barriers to screening. Also, it is important to consider, however, that barriers to bowel cancer screening are highly variable and that they may exert a greater influence on screening decisions in some individuals than in others.^{22,23} Therefore, it is possible that individual baseline differences in screening facilitators and barriers moderate the effectiveness of advance notification letters on screening intention. It is critical to investigate not only optimal letter modifications but also the subgroups most responsive to such changes.

Although advance notification letters used in screening programs in Australia and worldwide include behaviour change messaging, there is limited evidence to suggest the deliberate or systematic application of behaviour change theory in their design.²⁴ The NBCSP's current advance notification letter remains largely unchanged to date,

providing an opportunity to develop and test behaviour change theory integration in its design. Therefore, the current study aimed to:

- i) test the effect of two redesigned advance notification letters on bowel cancer screening intention, compared to the current NBCSP letter (control) and
- ii) explore how facilitators and barriers to screening may moderate the effect of advance notification on screening intention.

Method

Study design and recruitment

This study was designed and conducted in alignment with the 2010 Consolidated Standards of Reporting Trials (CONSORT) Statement: Updated Guidelines for Reporting Parallel Group Randomised Trials (a CONSORT checklist is provided in Supplementary File 1). This study used a parallel randomised controlled trial design in an online survey format hosted via Qualtrics.²⁵ Participants were randomly assigned 1:1 using Qualtrics' inbuilt randomiser function to view one of three advance notifications letters, with data collected before and after exposure. The sample (n=562) represented a subset of a larger, unpublished project investigating consumer perspectives on advance notification letters to inform the NBCSP. Australian residents aged 48-74 years were eligible to participate in the broader project; however, only those aged 50-74 years were included in this analysis to reflect the population of Australians eligible to automatically receive a screening kit from the NBCSP. A post hoc power analysis confirmed that this sample would retain at least 80% power to detect a small effect at α =0.05. Recruitment was conducted via an external agency specialising in representative health research samples.²⁵ A stratified sampling approach ensured balanced representation by gender, age (i.e. above and below 60 years of age) and previous screening status (i.e. returned vs. did not return their most recent NBCSP screening kit), accounting for known disparities in screening participation across these groups.⁴

Ethical approval was granted by the host institution's Human Research Ethics Committee (ref. H21REA152). Data collection took place from November 2022 to January 2023, with informed consent obtained from all individual participants.

Materials

Three advance notification letters were tested: a control letter and two redesigned versions.

Current NBCSP letter (control)

The control letter was the advance notification letter currently (as of 2023–2024) distributed by the Australian NBCSP (see Supplementary File 2). It briefly outlines the screening program's purpose, emphasises its importance for the target age group, provides contact information and notifies recipients that their test kit will arrive within 4–6 weeks. Whilst it includes motivational elements (e.g. a signed address from the Australian Chief Medical officer to leverage healthcare endorsement effects⁵), it lacks explicit grounding in behaviour change theory and does not incorporate the latest evidence on increasing screening intention. This makes it a suitable control for comparison with the redesigned letters.

Redesigned letters

Two redesigned letters were developed by the authors and the Australian Government Department of Health and Aged Care NBCSP team. Redesign 2 kept a traditional letter format, whereas Redesign 1 adopted a more visually engaging flyer-style layout. Both redesigned letters, however, incorporated colour, images and enhanced formatting not featured in the control letter. Though differing slightly in content, both redefined letters were grounded in current evidence on screening barriers and facilitators^{5,12,22,26-29} and developed with behaviour change experts. They aimed to enhance screening intention by (i) raising perceived risk, (ii) emphasising screening participation benefits and (iii) boosting screening self-efficacy. They also included messaging, targeting common barriers, including disgust, perceived difficulty, autonomy concerns, anticipated negative outcomes and avoidance behaviour. Finally, the letters were designed to reinforce the social normativity of screening participation by emphasising its widespread adoption (e.g. "Millions of Australians screen every year") and included healthcare professional endorsement.⁵ Additional design details and expert involvement are provided in Supplementary File 2.

Measures and procedure

Participants completed a 5- to 10-minute online survey via Qualtrics,³⁰ providing demographic details (age, gender, screening history and residential postcode). Postcode was used to determine geographical remoteness and area-level socioeconomic status based on the Australian Statistical Geography Standard Remoteness Structure³¹ and the Socio-Economic Index for Areas.³²

Participants were shown the NBCSP kit and its contents to (re) familiarise them with the screening program. At T1, before letter exposure, screening intention was measured using a single item: "How likely are you to complete and return your bowel cancer screening kit when you next receive it in the mail?" rated on a five-point Likert scale, where 1 = "Extremely unlikely" and 5 = "Extremely likely". Participants were then randomly assigned to view one of the three advance notification letters. At T2, following letter exposure, participants repeated the measure of screening intention using the item described earlier. Additionally, participants rated their levels of screening facilitators (risk perception, self-efficacy and positiveoutcome expectancies) and barriers (avoidance of negative outcomes, perceived lack of autonomy, difficulty, disgust and negative-outcome expectancies). Facilitators and barriers were measured using validated scales, the Process Approach to Mail-Out Screening scale²¹ and the Barriers to Bowel Cancer Screening (BB-CanS) scale.²² Measurements were collected using four- (barriers) or five-point (facilitators) Likert scales, with high scores representing higher levels of agreement with each statement. For example, response to the question "After viewing this letter, how likely do you think a diagnosis of bowel cancer is during your lifetime?" was used to measure screening facilitator, risk perception, where 1 = "Extremely unlikely" and 5 = "Extremely likely". For a full list of survey items, see Supplementary File 3.

Statistical analysis

Survey data were analysed using a linear mixed model (LMM) in R version 4.2.2, with the dplyr,³³ lme4,³⁴ nlme³⁵ and emmeans³⁶ packages. The LMM included a random intercept to account for the baseline variation in screening intention and a random slope accounting for changes in intention following letter exposure.

To address aim one, letter condition was added as a moderator to examine whether changes in screening intention differed between participants who viewed the control and redesigned letters. To control for their effect on screening intention, participant age, gender, arealevel socioeconomic status and prior exposure to an advance notification letter (determined by whether they had previously received an NBCSP kit) were included as covariates. For aim two, separate LMMs were run (with the previously covariates), each testing one barrier or facilitator as a moderator. Three-way interactions were also tested to assess whether changes in screening intention were dependent on an individual's scores on the barrier and facilitator items and whether this relationship varied across the three letter conditions.

Results

The sample had a mean age of 60.9 years [standard deviation (SD) = 7.4], with 50.9% participants being male; 45.2% of the participants reported not completing their most recent NBCSP screening kit. A total of 190 participants were assigned to view the control letter; 183 viewed Redesign 1, and 189 viewed Redesign 2. No significant differences in demographics were found across letter conditions (see Table 1).

Effect of the advance notification letters on screening intention

Table 2 presents LMM results. Participants' average screening intention increased from 3.69 (SD = 1.37) before letter exposure to 3.82 (SD = 1.33) after, indicating a significant rise in intention [the estimated effect of the predictors (*b*)=0.13, *p*<0.001, 95% confidence interval (Cl): (0.05, 0.21)]. However, this increase did not differ significantly between the control letter and the redesigned letters [control *vs.* Redesign 1: *b*=0.12, *p*=0.204, 95%Cl: (-0.07, 0.31); control *vs.* Redesign 2: *b*=0.07, *p*=0.471, 95%Cl: (-0.12, 0.26)].

Influence of facilitators and barriers on screening intention

Facilitators (Process Approach to Mail-Out Screening)

Anticipating greater personal benefit [b=0.12, p<0.001, 95%CI: (0.06, 0.18)] and higher self-efficacy [i.e. confidence in completing the kit; b=0.12, p<0.001, 95%CI: (0.06, 0.17)] after viewing the advance notification letters was associated with greater increase in screening intention (**Figure 1**). However, the perceived risk of bowel cancer did not affect the letters' impact on intention [b=-0.01, p=0.873, 95%CI: (-0.09, 0.07)].

Barriers (Barriers to Bowel Cancer Screening)

Participants who reported lower autonomy concerns [b=-0.23, p<0.001, 95%Cl: (-0.33, -0.13)], avoidance [b=-0.16, p=0.004, 95% Cl: (-0.26, -0.05)], perceived test difficulty [b=-0.20, p<0.001, 95%Cl: (-0.30, -0.10)] or disgust [b=-0.12, p=0.011, 95%Cl: (-0.22, -0.03)] after viewing the letters showed a greater increase in screening intention (see Figure 1). Anticipating negative outcomes did not moderate the effect of the letters on screening intention [b=-0.02, p=0.602, 95%Cl: (-0.09, 0.05)].

No significant three-way interactions were found; suggesting that the aforementioned moderating effects on screening intention were consistent across letter versions (see Supplementary File 4).

Discussion and conclusion

Overall, our findings show that advance notification letters elicit a small increase in bowel cancer screening intention, aligning with prior evidence.^{5,7} Contrary to expectations, redesigning the letters based

Table 1: Sample characteristics. ^a										
Demographic	Total sa (n=5	Total sample (n=562)		Control letter (n==190)		Redesign 1 (n=183)		Redesign 2 (n==189)		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)		
Age (years)	60.9	7.4	60.7	7.1	61.3	7.5	60.6	7.5		
	%	(n)	%	(n)	%	(n)	%	(n)		
Gender Male	50.9%	286	47.4%	90	51.9%	95	53.4%	101		
Female	48.8%	274	52.1%	99	47.5%	87	46.6%	88		
Born in Australia Yes	73.3%	412	75.3%	143	68.9%	126	75.7%	143		
No	26.7%	150	24.7%	47	31.2%	57	24.3%	46		
Aboriginal and/or Torres Strait Isla Yes	nder identity 5.2%	31	6.3%	12	4.9%	9	5.3%	10		
No	93.4%	525	92.6%	176	94%	172	93.7%	177		
Area-level SES (Quintile) ^b										
1 st (most disadvantaged)	20.7%	116	21.6%	41	20.3%	37	20.1%	38		
2 nd	19.6%	110	22.6%	43	15.9%	29	20.1%	38		
3 rd	22.6%	127	22.6%	43	19.8%	36	25.4%	48		
4 th	18%	101	13.7%	26	21.4%	39	19.1%	36		
5 th (least disadvantaged)	19.1%	107	19.5%	37	22.5%	41	15.3%	29		
Region ^b Major city	71.8%	403	74.2%	141	72.5%	132	66.8%	130		
Inner regional	19.4%	109	15.3%	29	20.3%	37	22.8%	43		
Outer regional/remote	8.7%	49	10.5%	20	7.1%	13	8.5%	16		
Previously received an NBCSP kit Yes	78.5%	441	27.4%	154	143	25.4%	144	25.6%		
No/Unsure	21.5%	121	6.4%	36	40	7.1%	45	8%		
Completed most recent NBCSP kit	220/	100	22 20/	63	21 70/	50	21 20/	50		
No.	32% 45.20/	180	55.2%	03	31./%	2ð 01	31.2%	27		
	45.2%	204	40.8%	89	44.3%	ŏ1	44.4%	84		
No — regular colonoscopies	22.8%	128	20%	38	25.1%	46	23.8%	45		

NBCSP = National Bowel Cancer Screening Program; SD = standard deviation.

^aChi-squared tests revealed no significant differences in sample demographics between any of the letter conditions.

^bArea-level socioeconomic status (SES) and regional status were calculated using residential postcode and the Australian Bureau of Statistics 2016 geography standards.³¹

on expert guidance and behaviour change theory did not enhance screening intention beyond the current NBCSP letter. One possible explanation for this finding may be that the effectiveness of advance notifications may not hinge solely on specific messaging or design. Rather, the early provision of information, allowing additional time for contemplation, may be the crucial factor underlying its positive effect on screening intention and participation. This insight opens new avenues for exploring modifications to advanced notifications beyond content-related changes. Evidence indicates that digital notifications (i.e. via text message or email) can increase bowel cancer screening participation³⁷⁻³⁹ and may increase cost-effectiveness by reducing printing and postal costs. However, these digital notifications remain underutilised in screening programs and warrant further investigation.²⁴ Directly comparing the efficacy of digital versus printed advance notifications could help optimise their use in screening programs. Additionally, the timing of notification delivery relative to kit arrival may influence their effectiveness, particularly in reducing the risk of forgetting. Research has yet to examine whether manipulating this interval could moderate the letter's effect on screening uptake.²⁴ Future research exploring these modifications could help refine this intervention for maximum effectiveness.

An alternative explanation for the failure of the advance notification letter redesigns to increase screening intention above the control may

be due to the type of decision-making process engaged. According to dual process theory,⁴⁰ decision-making involves two cognitive systems: fast automatic "Type I" processing and slower, deliberative "Type II" processing.^{41,42} The screening intention captured in this study likely resulted from "Type I" processing as it was measured immediately following exposure to the notification letter. The additional motivational content in the redesigned letters may require more time for Type II processing to engage, process and influence screening motivation. Whilst immediate responses provide valuable insights into heuristic-driven health decisions,⁴³ future research could benefit from multiple measurements of screening intention, spanning from post-exposure up to the kit's arrival. Such a longitudinal approach could offer deeper insights into how and when advance notifications influence screening intention, optimising delivery strategies for population screening programs.

Implications for public health

The current results suggest that the immediate impact of advance notification letters on screening intention may depend less on explicit behaviour change content and more on individual differences in perceived screening barriers and facilitators. Specifically, individuals with high levels of disgust, autonomy concerns, perceived test difficulty and avoidance tendencies after reading the letters showed

Table 2: Linear mixed-model output (fixed effects).											
	Effect of advance notification	Moderating effects of letter redesigns	Moderating effects of barriers				Moderating effects of facilitators				
	Time (pre-exposure <i>vs.</i> postexposure)	Time $ imes$ letter version	Time $ imes$ autonomy concerns	Time $ imes$ avoidance	Time $ imes$ difficulty	Time $ imes$ disgust	Time $ imes$ negative outcome	Time $ imes$ positive outcome	Time $ imes$ risk perception	Time $ imes$ self-efficacy	
AIC ^a	3382.568	3388.646	3247.38	3313.444	3259.502	3293.746	3356.332	3020.138	3339.034	2975.229	
BIC ^b	3432.814	3458.991	3307.676	3373.74	3319.798	3354.042	3416.628	3080.433	3399.330	3035.524	
LLC	—1681.284	-1680.323	—1611.69	—1644.722	—1617.751	—1634.873	—1666.166		—1657.517	—1475.614	
(Interce b	pt) 4.428***	4.441***	4.675***	4.862***	5.941***	4.863***	4.850***	1.883***	2.825***	2.242***	
SE	0.495	0.511	0.473	0.500	0.480	0.485	0.508	0.443	0.562	0.415	
t	8.938	8.690	9.884	9.727	10.303	10.032	9.549	4.252	5.031	5.397	
Slope b	0.132***	0.122/0.069 ^d	-0.232***	-0.155**	-0.197***	-0.123*	-0.019	0.117***	-0.007	0.119***	
SE	0.039	0.097/0.096 ^d	0.052	0.054	0.050	0.048	0.037	0.031	0.041	0.029	
t	3.347	1.271/0.721 ^d	-4.496	-2.873	-3.910	-2.563	-0.521	3.724	-0.160	4.118	

Note. Screening facilitators and barriers were tested as moderators of the effect of advance notification on screening intention. b refers to the estimated effect of the predictor(s) on screening intention. For results of the 3-way moderation analysis (time × mechanisms/barriers × letter version), see Supplementary File 4. SE, Standard error.

*p<0.05, **p<0.01, ***p<0.001. ^aAIC = Akaike information criterion.

^bBIC = Bayesian information criterion. ^cLL = Log likelihood.

^dControl letter versus Redesign 1/control letter versus Redesign 2.



Figure 1: Influence of facilitators and barriers on screening intention. *Note*. Asterisks denote statistical significance of the moderation effects, where *p < 0.05, **p < 0.01 and ***p < 0.001. SD = standard deviation.

🔶 +1 SD 🔶 Mean 🔶 -1 SD

reduced increases in screening intention compared to those who reported lower levels of these barriers. Conversely, individuals reporting higher perceived benefits of screening and greater selfefficacy in response to the letter showed larger increases in screening intention than those with weaker perceptions of these facilitators. However, the perceived risk of bowel cancer and anticipating negative screening consequences did not influence the letters' effect on screening intention, suggesting these factors may not contribute to the effectiveness of advance notification letters.

It was initially surprising that anticipated negative screening outcomes did not affect the letters' impact on screening intention, whilst avoidance tendencies did as both barriers reflect expectations of adverse screening-related consequences. The key difference may lie in the emotional response each barrier implies. Since avoidance behaviour is often associated with anxiety,⁴⁴ a tendency to *avoid* screening may indicate a greater level of anxiety or worry, beyond merely expecting adverse personal impacts. For those highly anxious individuals, advance notification letters may not adequately address their concerns to increase the willingness to participate. Targeted interventions may be required to support those particularly concerned or fearful about participating in bowel cancer screening.

Overall, our findings suggest that individual reactions to an advance notification letter can influence its effectiveness and that this intervention may primarily enhance screening intention for individuals whose screening-related concerns are adequately addressed, who perceive benefits of screening and who have high self-efficacy regarding completion of the screening kit. This underscores that advance notification letters are not a "one-size-fitsall" approach to alleviating screening barriers and enhancing facilitators amongst all prospective invitees. Prior research has identified factors that may contribute to individual differences in screening communications, including the fear of the screening outcome and prior screening behaviours.^{45,46} These psychological and behavioural factors may shape whether an individual perceives the letter as reassuring or distressing, thereby influencing its impact on intention. Given this variability, previous research suggests that combining multiple intervention strategies can increase the population-level screening participation more effectively than using a single strategy⁴⁷ as different strategies may be better suited to different individuals. As such, advance notifications may be more effective if delivered in tandem with other intervention strategies to better address the unique screening barriers faced by individuals.

Study limitations

The findings of this study should be considered in light of its limitations. The advance notification letters were presented in a hypothetical scenario, where participants imagined their responses as if they received the letter by mail. This introduces uncertainty about whether the observed responses accurately reflect those that would occur in a more naturalistic setting. The proximity of T1 and T2 measures of screening intention may also have introduced an order-effect bias, leading participants to maintain consistency in their ratings of intention before and after letter exposure. Future exploration of the effect of a redesigned advance notification letter on intention may yield different results with an increased time delay between T1 and T2 measurements. Furthermore, design and content

differences between the letters (see Supplementary File 2) were modest as policy and practical constraints limited changes to the redesigned letters. More substantial modifications might have shown a stronger effect on screening intention than on the control.

Additionally, this study investigated screening intention rather than behaviour. Although intention is an imperfect predictor of screening participation,⁴⁸ understanding the processes which impact it has important theoretical implications, aligning with the transtheoretical model's proposition that advance notification can increase screening uptake by enhancing "readiness" or motivation to screen. Participants' levels of screening barriers and facilitators were conceptualised in this study as individual-level factors that may moderate the impact of an advance notification letter on intention. However, it is also possible that exposure to an advance notification letter directly influences these factors, which may in turn shape screening intention. Given the absence of baseline measures, we could not assess whether changes in screening barriers and facilitators mediated the effect of the letter on intention. Mediation analysis was, therefore, beyond the scope for this study. Future research should obtain both baseline and post-exposure measures to better understand how advance notifications influence these psychosocial factors and ultimately, screening intention. Additionally, this study did not assess the moderating role of participants' sociodemographic factors, although prior work suggests that characteristics such as gender and culture may also influence the effectiveness of screening interventions.⁴⁹ However, it is important to note that whilst such factors may moderate responses to advance notification letters, they are immutable characteristics the letter itself cannot influence. Future work should investigate how advance notification letters can be tailored to engage individuals by targeting variables modifiable to intervention whilst also considering the moderating effect of demographic characteristics and identifying intervention strategies most effective for different population subgroups. This trial was not prospectively registered.

Conclusion

Our results indicated that whilst advance notification letters increase bowel cancer screening intention, our attempts to enhance their effectiveness through theory-informed modifications to content and design were ineffective. Future research should explore non-contentrelated modifications, such as digital delivery or optimised timing, to potentially improve efficacy. Additionally, tracking screening intention over time post exposure may provide insights into how this intervention influences screening intention as individuals contemplate the message. Variability in individual responses suggest that a multi-pronged approach addressing diverse screening barriers may further enhance population bowel cancer screening in Australia and beyond.

Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Mark Jenkins reports a relationship with National Bowel Cancer Screening Program, Clinical Advisory Group that includes board membership. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical approval statement

The authors assert that all procedures relating to this work comply with the World Medical Association Declaration of Helsinki (1979), and the ethical standards of the relevant national and institutional committees on human experimentation. Ethical approval was obtained for this study from the University of Southern Queensland's Human Research Ethics Committee (ref. H21REA152, approved 21/ 10/2022).

Author contributions

KC: conceptualisation, methodology, formal analysis, data curation, writing—original draft and preparation, writing – review and editing and visualisation.

MI: conceptualisation, writing-review and editing and supervision.

LM: conceptualisation, methodology, formal analysis, investigation, data curation, writing—review and editing and supervision.

MJ: writing—review and editing and funding acquisition.

JM: writing—review and editing and funding acquisition.

CW: writing—review and editing and funding acquisition.

NT: writing—review and editing and funding acquisition.

BG: conceptualisation, investigation, writing—review and editing, supervision and funding acquisition.

Data availability statement

The data that support the findings of this study are available upon direct request to the corresponding author.

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Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi. org/10.1016/j.anzjph.2025.100246.