SUPPLEMENTARY INFORMATION

Nationwide demonstration of improved COVID-19 vaccination uptake through behavioural reminders

Hannah Behrendt, Giulia Tagliaferri, Lev Tankelevitch, Yihan Xu, Hugo Harper, Natalie Gold, Dale Weston, Rachel Rosen, Robert Scott

Corresponding author: Hannah Behrendt, hannah.behrendt@bi.team

Supplementary Methods

Study design and participants - study 1 and 2

Both trials were pragmatic, parallel, single-blinded randomised controlled trials. They each involved the full population of NHS patients invited to receive the COVID-19 vaccine at that point in time. Supplementary Table 1 (in Supplementary Tables Section below) summarises the main differences between the two studies in terms of sample and trial characteristics.

The unit of randomisation for both trials was the individual, and the outcomes (whether a participant booked their vaccination within 72 hours from being sent the text message invitation; whether a participant received a vaccination within 14 days from being sent the text message invitation) were also measured at the individual level. Outcome data were collected by NHS England and NHS Improvement via the NIMS database as a business-as-usual process. Before transferring data to the study authors, NHS England and NHS Improvement pseudonymised participants' NHS numbers.

For both studies, the NHS Research Ethics Committee (21/SW/0055) waived participant consent for these trials, as obtaining consent risked undermining the study results and was deemed disproportionate to the intervention, as the intervention itself did not affect the clinical treatment being provided to patients.

Randomisation and masking

NHS England and NHS Improvement randomly assigned participants to one of the groups (eight groups for study 1, seven groups for study 2). The randomisation process was conducted as follows. First, records of participants eligible for vaccination were selected for inclusion in each invitation run. Second, a random number was generated via an inbuilt random number generator function and assigned to each participant on an equal allocation basis. In order to do this, the inbuilt pseudo-random number generator function $RANDOM(.) of the database's system programming language, Intersystems Caché, was used to generate an integer in the range of zero to seven, then prefixed with "A0" in order to allocate the trial arm code (A00-A07 for study 1, A00-A06 for study 2). The function allocated the trial arm code on a person-by-person basis as the data was being processed. Once complete, the file including the trial arm code was passed to a hybrid mailer used to generate the text message content associated with the assigned trial code.

Upon receiving the text message, participants were likely to be aware of the intervention they were assigned to, but unaware that they were involved in a trial, meaning participants were blind to intervention. The study team was not blind to group assignment, as this was not practical within the timeframe of the study.power

Statistical analysis - study 1 & 2

In March 2021, when planning for study 1, we used the most recent data available on vaccination rates to estimate that we would require a sample including three year groups (1.632 million people) to be able to observe a 0.44 percentage point change in the vaccination booking rate within 72 hours with 80% power (using the Bonferroni method to adjust for multiple comparisons, as a conservative approach to estimating power) among the general population. We also wanted to make sure to be able to detect a reasonably small but important backfire of 2 percentage points among specific ethnic groups characterised by low vaccination rates, were such an effect real. The size of some ethnic groups (as determined by NHS ethnicity codes) was too small to be powered to observe the two percentage point change in booking rates. We therefore combined the smallest groups with other groups with similar vaccine uptake rates among age cohorts who had been invited for vaccination prior to our trial, so that each newly formed grouping was expected to be larger than 70,000 people, based on estimates provided by the NHS (see Supplementary Table 2). This was also triangulated by the NHS with polling data on expected vaccine uptake among the trial age cohort, which also indicated similarity in anticipated vaccine uptake among the small ethnic groups which were combined.

Ultimately, this meant that the trial was simultaneously powered to detect a 0.44 percentage point change in the vaccination booking rate within 72 hours among the general population, and a 2 percentage point change among the ethnic groups analysed (with 80% power, using the Bonferroni method to adjust for multiple comparisons, as a conservative approach to estimating power). Note that this study, as well as study 2, were neither powered nor intended to study heterogeneity in effect size; the aim of the preregistered ethnic subgroup analyses was to rule out sizeable backfire effects among ethnic groups with anticipated low booking rates.

At the implementation stage for study 1, eligibility was opened to more than one group at the same time. As a result, the trial included five age groups instead of three (ages 40, 41, 42, 43 and 44) leading to a study sample of 1,825,937 (after invalid phone numbers, of which there were more than anticipated in our power calculations, were excluded). In turn, this meant the trial was powered to detect a difference of ~0.4 percentage points instead of 0.44 (~10% smaller than planned).

In May 2021, we ran power calculations for study 2 following a similar approach to study 1. Again, we used the most recent data available on vaccination rates and invalid phone numbers to estimate that we would require a sample including five year groups (2.8 million people) to be able to observe (i) a 0.3 percentage point change in the vaccination booking rate within 72 hours among the general population; and (ii) and a 2 percentage point change among the ethnic groups analysed (with 80% power, using the Bonferroni method to adjust for multiple comparisons, as a conservative approach to estimating power).

Both trials were analysed using an intention-to-treat (ITT) approach, meaning that we analysed all participants who were sent messages according to the group they were randomised into, regardless of message delivery status. Our primary analysis of the booking rate used a logistic regression model applied to the individual-level booking data. The dependent variable was a dummy variable taking value 1 if the participant made a booking within 72 hours of being sent the text message and 0 otherwise (see *Outcomes* section above for details). The main regressors were a set of dummy variables, each variable representing one of the seven behaviourally informed messages. The reference group was the group receiving the "Control" text message reminder, meaning that treatment effect comparisons are treatment versus control. In order to increase the precision of the estimates, we also included a set of covariates in the model: dummy variables for each age group, gender, ethnic grouping and day of the week the message was sent as well as the time of day the message was sent as a continuous variable (measured in seconds). P-values for the treatment coefficients (relative to control) were adjusted for multiple comparisons using the Benjamini-Hochberg correction with a maximum false discovery rate of five percent.

As a pre-specified secondary analysis, we also conducted a subgroup analysis for each of the seven ethnic group indicators (see Supplementary Table 2) to identify any messages that were particularly (in)effective compared to the control message (see p.16 of Trial Protocol for study 1). These analyses used a logistic regression model similar to that above, but with the sample restricted to a different ethnic subgroup each time. As in the primary analysis, p-values for the seven treatment coefficients were adjusted for multiple comparisons using the Benjamini-Hochberg correction, treating each ethnic group as a separate family of hypothesis tests, with a maximum false discovery rate of five percent.

Analogous regression specifications were used for the analysis of the secondary outcome, vaccination rate within 14 days (for the full sample and ethnic subgroup samples). For each analysis, p-values for the treatment coefficients were adjusted for multiple comparisons using the Benjamini-Hochberg correction as described above.

Supplementary Results

Results for the primary outcome - booking rate through the NHS National Booking System within 72 hours of text messages being sent

The overall patterns for the primary outcome were similar to those of the secondary outcome (vaccination uptake), reported in the main text of the paper. The booking rate was originally chosen as the primary outcome, as very rapid information on the messages' possible effectiveness was required to inform the ongoing vaccine rollout. However, as vaccination uptake is the ultimate outcome of interest we report the full results for this secondary outcome in the main paper while sharing the full results for the primary outcome here.

In study 1, in the group that was sent the "Control" message, the booking rate within 72 hours was 23.02% (95% CI 22.85-23.19%). Compared to the "Control" message, the "Top of queue" message increased the booking rate by 0.45 percentage points (pp) or 1,028 people.

The odds ratio (OR) for the difference between the messages was 1.03 (95% CI 1.01-1.04, p = 0.0026 adjusted for multiple comparisons using the Benjamini-Hochberg procedure). Booking rates within 72 hours for groups sent the other six messages were not statistically significantly different from the control group at the conventional 0.05 significance level (see Supplementary Figure 1 and Supplementary Table 4). One of the messages ("Join the millions") had a directionally negative effect that would be significant at a 0.1 significance level, decreasing the booking rate by 0.28 pp or 636 people compared to the control, with aOR of 0.98 (95% CI 0.97-1, p = 0.0951 adjusted for multiple comparisons using the Benjamini-Hochberg procedure).

In study 2, in the group that was sent the "Control" message, the booking rate within 72 hours was 12.68% (95% CI 12.56-12.79%). The original "Top of the queue" message led to an increase in the booking rate by 0.60 pp (or 1,841 people), corresponding to an OR of 1.05 (95% CI (1.04-1.07), adjusted $p < 0.001$). The "Top of queue + Convenience" was the best performing message, increasing the booking rate by 0.68 percentage points (pp) or 2,105 people. The odds ratio (OR) for the difference between the messages was 1.06 (95% CI (1.05-1.08), adjusted $p < 0.001$). Last, the rephrased "Front of the queue" message led to a 0.44 pp (or 1,340 people) increase in the booking rate (OR 1.04, 95% CI (1.02-1.05), adjusted $p < 0.001$). The booking rate for the groups being sent the "Reserved" and "Convenience" messages were not statistically significantly different from the control group at the conventional 0.05 significance level (see Supplementary Figure 2 and Supplementary Table 11 for more details).

Subgroup analyses by ethnic group

In this section, we provide additional results for the subgroup analyses we ran in study 1 and 2. In both studies we conducted pre-specified secondary subgroup analyses for each of seven ethnic group indicators available to identify messages that were particularly (in)effective, compared to the "Control" message (see p.16 of Trial Protocol for study 1). We conducted this analysis by subsetting our data using the ethnic group indicators (as specified in p.16 of Trial Protocol for study 1).

In study 1, for the primary outcome measure (booking rate within 72 hours of text messages being sent), the only statistically significant effect was for those categorised as 'White'. For this group, the unadjusted booking rate within 72 hours for the "Control" message was 29·07% (95% CI 28·8-29·34%). The "Top of queue" message increased the booking rate by 0.55 pp. The adjusted OR for the difference between these messages was 1·03 (95% CI 1·01-1·05) p = 0·0335). No other message was statistically significantly different from control in the White group or any other ethnic group (Supplementary Table 6) on booking rates.

For the secondary outcome measure, in participants categorised as 'White', the unadjusted vaccination rate within 14 days for the "Control" message was 34·01% (95% CI 33·73-34·29%). The "Top of queue" message increased the vaccination rate by 0.55 pp (adjusted OR comparing these messages was 1·02 (95% CI 1·01-1·04, p = 0·0485). No other

message was statistically significantly different from control in the White, Other White, or any other ethnic group (Supplementary Table 7) on vaccination rates.

In study 2, we found similar results. For the primary outcome measure (booking rate within 72 hours of text messages being sent), we found statistically significant effects for those categorised as 'White' and 'Unknown' (the two largest groups), largely mirroring the effects we found in the primary analysis. For the 'White' group, the unadjusted booking rate within 72 hours for the "Control" message was 16·4% (95% CI 16·21-16·59%). The "Top of queue" message increased the booking rate by 0.79 pp. The adjusted OR for the difference between these messages was 1·06 (95% CI 1·04-1·08) $p < 0·0001$). The impact of the other two messages with a 'queue' component was also statistically significant: 'Top + Convenience' increased the booking rate by 0·93 pp (OR 1·07 (95% CI 1·05-1·09) $p < 0·001$)); 'Front' increased the booking rate by 0·58 pp (OR 1·04 (95% CI 1·02-1·06) $p < 0·001$)). For the 'Unknown' group, the unadjusted booking rate within 72 hours for the 'Control' message was 10·72% (95% CI 10·46-10·99%). The 'Top of queue' message increased the booking rate by 0.9 pp. The adjusted OR for the difference between these messages was 1·1 (95% CI 1·05-1·14) $p < 0·001$). 'Top + Convenience' increased the booking rate by 0·72 pp (OR 1·08 (95% CI 1·04-1·12) $p < 0·001$)). 'Reserve + Convenience' increased the booking rate by 0·46 pp (OR 1·04 (95% CI 1·01-1·09) $p = 0·0339$)). No other message was statistically significantly different from control in other ethnic groups (Supplementary Table 11) on booking rates.

The same significance pattern can be observed for the secondary outcome measure, vaccination rate within 14 days. Among participants categorised as 'White', the unadjusted vaccination rate within 14 days for the 'Control' message was 30·95% (95% CI 30·71-31·19%). The 'Top of queue', 'Top + Convenience' and 'Front' messages increased the vaccination rate by 1·23 pp (OR 1·06 (95% CI 1·04-1·08, $p < 0·001$), 1·44 pp (OR 1·07 (95% CI 1·05-1·09, $p < 0·001$), 0·9 pp (OR 1·04 (95% CI 1·02-1·06, $p < 0·001$) respectively. Among participants categorised as 'Unknown', the unadjusted vaccination rate within 14 days for the 'Control' message was 19·8% (95% CI 19·46-20·14%). The 'Top of queue' and 'Top + Convenience' messages increased the vaccination rate by 1·48 pp (OR 1·1 (95% CI 1·05-1·14, $p < 0·001$) and 1·19 pp (OR 1·08 (95% CI 1·04-1·12, $p < 0·001$) respectively. The 'Reserved + Convenience' message increased the vaccination rate by 0·75 pp (OR 1·05 (95% CI 1·01-1·09, $p = 0·0339$) (Supplementary Table 12).

As an additional exploratory analysis, we conducted a multivariate regression that included an interaction term between a binary variable indicating whether an individual was of British White or Irish White ethnicity (versus all other ethnicity groups) and a set of dummy variables for each treatment arm. This analysis was performed for the primary and secondary outcomes for both trials. The results did not provide any evidence of heterogeneous treatment effects, with the lowest p-value, adjusted for multiple comparisons using the Benjamini-Hochberg procedure, being 0.17. Regression outputs are available upon request.

Subgroup analyses by sex

In both studies we also conducted subgroup analyses by sex. These results are presented in Supplementary Tables 8, 9, 15, 16. In study 1, male trial participants (55% of the sample) who were sent the "Top of queue" message had a statistically significant higher booking rate within 72 hours of text messages being sent (increased booking rate by (0·48 percentage points; OR 1·03 (1·01-1·05), p = 0·0314 adjusted for multiple comparisons). An increase of similar magnitude (0.41 percentage points) is observed among women, however this is not statistically significant at conventional levels. When splitting the sample by sex, we are not able to see any statistically significant difference in the vaccination rate of men and women sent behavioural informed messages, compared to men and women sent the "Control" message. In study 2, we find that the effects of the best performing behavioural messages ("Top"; "Top + Convenience"; "Front") are more sizeable (and more likely to reach statistical significance) among men than among women, both for booking rates and vaccination rates. For example, The "Top of queue" message increase vaccination rates by 0.46 percentage points among men (OR 1·03 (1·01-1·04), p = 0·0121 adjusted for multiple comparisons) and 0.36 percentage points among women (OR 1·02 (1·00-1·04), p = 0·0653 adjusted for multiple comparisons).

Last, we performed an analysis of the treatment on the treated, by excluding all trial participants that we know did not receive the text messages. Results are consistent with the results presented in our main analysis and are available upon request.

Supplementary Discussion

Calculating the real world impact of study 1 and study 2

The "Top of queue" message was rolled out nationally to people aged 30-37 upon completion of study 1, and it was further rolled out to people aged 18-24 upon completion of study 2.

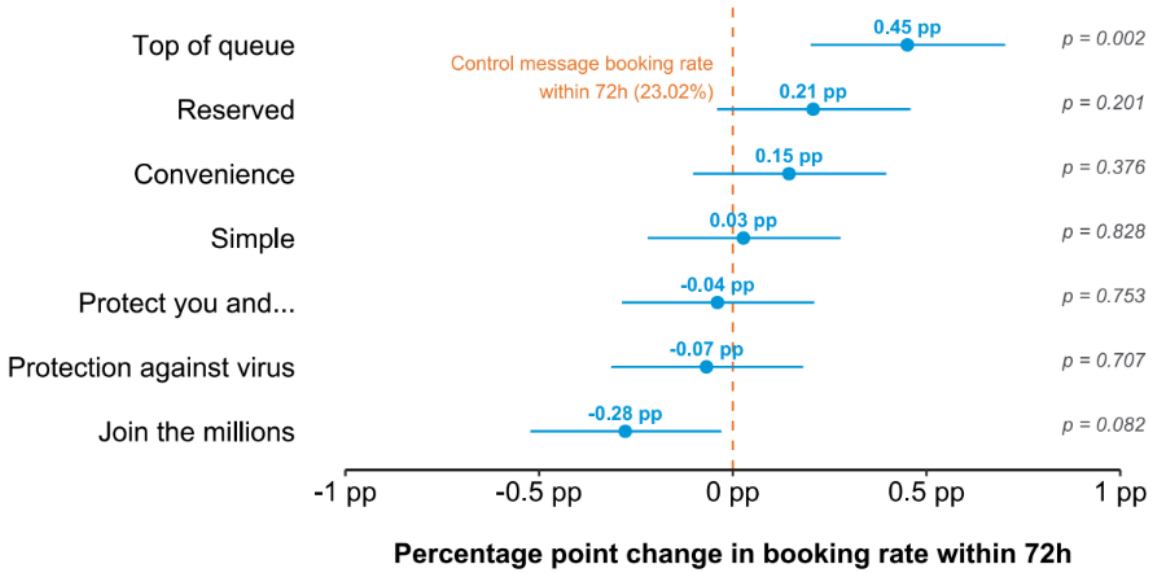
To calculate the real world impact of the two trials combined, we estimated the increase in vaccination rates within 14 days in cohorts 30-37 and 18-24, caused by having sent the 'Top of queue' message in place of a "Control" message.

NHS England and NHS Improvement provided the required information about the number of people in each cohort with valid phone numbers (18-24 years old; 30-34 years old; 35-37 years old). For this exercise, we assumed that the "Top of queue" message was similarly effective in cohort 30-37 as it was in study 1 (conducted among people aged 40-44 years old) and similarly effective in cohort 18-24 as it was in study 2 (conducted among people aged 25-29 years old). These are conservative estimates, as assuming that "Top of queue" message was similarly effective in cohort 30-35 as it was among people aged 25-29 years old would have led to larger real world impact estimates. We also assumed that the demographic composition of these cohorts is similar to the cohort included in our two experiments.

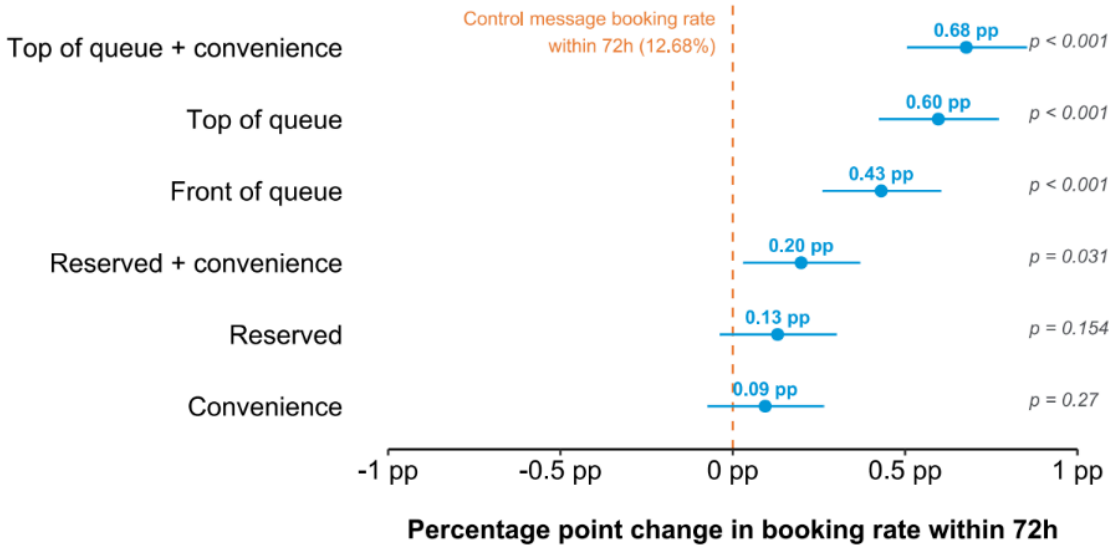
Our calculations show that the real world impact of the roll-out of "Top of the queue" was an additional 42,000 [95% CI: 23,000, 61,000] first-dose COVID-19 vaccinations being received within 14 days of messages being sent, among cohorts 30-37 and 18-24 and among the trial participant being sent the "Top of the queue" reminder. After applying the

James-Stein estimator to mitigate for the effects of the ‘winner’s curse’, this estimate decreases to 33,000.

Supplementary Figures



Supplementary Figure 1: Adjusted percentage point change in booking rate within 72 hours for each treatment text message reminder compared to control text message reminder in study 1, with 95% CIs. (Note: Sample size study 1 = 1,825,937. The "Control" message booking rate is unadjusted for covariates. 95% CIs are not adjusted for multiple comparisons, whereas p-values are adjusted for multiple comparisons using the Benjamini-Hochberg correction.)



Supplementary Figure 2: Adjusted percentage point change in booking rate within 72 hours for each treatment text message reminder compared to control text message reminder in study 2, with 95% CIs. (Note: Sample size study 2 = 2,506,004. The "Control" message vaccination rate is unadjusted for covariates. 95% CIs are not adjusted for multiple comparisons, whereas p-values in the graph are adjusted for multiple comparisons using the Benjamini-Hochberg correction.)

Supplementary Tables

Supplementary Table 1: Summary of key differences between study 1 and study 2

Study	**1**	**2**
Sample size	1,825,937	2,506,004
Cohort	Patients aged 40-44 (and those aged 39 who were due to turn 40 years old before 1 July 2021)	Patients aged 24-29 (and those aged 23 who were due to turn 24 years old before 1 July 2021)
Inclusion criteria	(i) satisfying the age criteria as defined above; (ii) recorded in the National Immunisation Management System (NIMS); (iii) with a valid mobile phone number; (iv) who had not already received or been invited for the COVID-19 vaccine via NIMS at the time of the study.	(i) satisfying the age criteria as defined above; (ii) recorded in the National Immunisation Management System (NIMS); (iii) with a valid mobile phone number; (iv) who had not already received or been invited for the COVID-19 vaccine via NIMS at the time of the study; (v) who had not booked an appointment or been vaccinated before the text message was sent.
Recruitment period	April 26th - April 30th, 2021	June 8th - June 12th, 2021
Number of trial arms	8 arms	7 arms

Supplementary Table 2: Ethnic group definitions used for analysis (sorted by estimated relative size at study 1 design stage).

Ethnic group	NHS Ethnicity codes	Estimated Group size at study 1 design stage
White	A: British, Mixed British; B: Irish	836,000
Unknown	Missing (99)	254,000
Other White	C: Any other White background	207,000
Pakistani, Bangladeshi, Other Asian	J: Pakistani or British Pakistani; K: Bangladeshi or British Bangladeshi; L: Any other Asian background	88,000
Indian, White & Asian, Other Mixed	H: Indian or British Indian; F: White and Asian; G: Any other mixed background	72,000
Black, Mixed White & Black	M: Caribbean; N: African; P: Any other Black background; D: White and Black Caribbean; E: White and Black African	71,000
Other	R: Chinese; S: Any other ethnic group; W: Arab; T: Traveller	71,000

Note: The coding and categorisation scheme of the ethnic groups is adopted from the National Immunisation Management Service (NIMS) system. The number and categorisation of specific subgroups was decided in accordance with the NHS by preliminary power calculations based on expected sample size (as specified in the protocol) and relative similarity of vaccination rates (not specified in the protocol).

Supplementary Table 3: Baseline characteristics by treatment allocation - study 1.

	Control	Simple	Reserved	Top of queue	Join the millions	Convenience	Protection against virus	Protect you and...
Age (years)								
39	13747 (6·02%)	13495 (5·92%)	13638 (5·99%)	13478 (5·91%)	13725 (6%)	13473 (5·91%)	13673 (5·99%)	13550 (5·93%)
40	49441 (21·66%)	49041 (21·51%)	49008 (21·52%)	49182 (21·55%)	49566 (21·65%)	49182 (21·57%)	49392 (21·64%)	49070 (21·47%)
41	46330 (20·3%)	46202 (20·27%)	46427 (20·39%)	46217 (20·25%)	46254 (20·2%)	46454 (20·37%)	46089 (20·19%)	46135 (20·19%)
42	41117 (18·02%)	41251 (18·09%)	41124 (18·06%)	41211 (18·06%)	41351 (18·06%)	41199 (18·07%)	41468 (18·17%)	41459 (18·14%)
43	38316 (16·79%)	38502 (16·89%)	38254 (16·8%)	38574 (16·9%)	38699 (16·9%)	38313 (16·8%)	38242 (16·76%)	38621 (16·9%)
44	39281 (17·21%)	39497 (17·32%)	39267 (17·24%)	39580 (17·34%)	39335 (17·18%)	39433 (17·29%)	39357 (17·25%)	39717 (17·38%)
Sex								
Female	102654 (44·98%)	101916 (44·7%)	102267 (44·91%)	102552 (44·93%)	102773 (44·89%)	102309 (44·86%)	102410 (44·87%)	102148 (44·69%)
Male	125574 (55·02%)	126068 (55·3%)	125447 (55·09%)	125682 (55·07%)	126145 (55·1%)	125739 (55·14%)	125805 (55·12%)	126400 (55·3%)
Unknown	4 (<0.01%)	4 (<0.01%)	4 (<0.01%)	8 (<0.01%)	12 (0·01%)	6 (<0.01%)	6 (<0.01%)	4 (<0.01%)
Ethnic group								
White	107793 (47·23%)	107946 (47·35%)	107616 (47·26%)	108328 (47·46%)	108294 (47·3%)	108078 (47·39%)	108033 (47·34%)	108060 (47·28%)
Unknown	38723 (16·97%)	38784 (17·01%)	38810 (17·04%)	38899 (17·04%)	39297 (17·17%)	38849 (17·04%)	38926 (17·06%)	39391 (17·24%)
Other White	33727 (14·78%)	33337 (14·62%)	33345 (14·64%)	33472 (14·67%)	33787 (14·76%)	33280 (14·59%)	33615 (14·73%)	33815 (14·8%)
Pakistani, Bangladeshi, Other Asian	14250 (6·24%)	14085 (6·18%)	14281 (6·27%)	13831 (6·06%)	14139 (6·18%)	14087 (6·18%)	14003 (6·14%)	13899 (6·08%)
Indian, White & Asian, Other Mixed	11839 (5·19%)	11818 (5·18%)	11850 (5·2%)	11877 (5·2%)	11592 (5·06%)	11800 (5·17%)	11827 (5·18%)	11572 (5·06%)

Black, Mixed White & Black	11059 (4·85%)	11231 (4·93%)	11065 (4·86%)	11065 (4·85%)	11194 (4·89%)	11170 (4·9%)	11073 (4·85%)	11066 (4·84%)
Other	10841 (4·75%)	10787 (4·73%)	10751 (4·72%)	10770 (4·72%)	10627 (4·64%)	10790 (4·73%)	10744 (4·71%)	10749 (4·7%)
Day of week message sent								
Monday	49676 (21·77%)	49848 (21·86%)	49656 (21·81%)	50139 (21·97%)	49765 (21·74%)	49833 (21·85%)	49761 (21·8%)	50244 (21·98%)
Tuesday	80360 (35·21%)	80472 (35·3%)	80295 (35·26%)	80592 (35·31%)	80992 (35·38%)	80471 (35·29%)	80556 (35·3%)	80958 (35·42%)
Friday	98196 (43·02%)	97668 (42·84%)	97767 (42·93%)	97511 (42·72%)	98173 (42·88%)	97750 (42·86%)	97904 (42·9%)	97350 (42·59%)
Time message sent (hours, minutes, seconds; GMT+01)								
Average time sent	11:32:30	11:32:32	11:32:50	11:33:24	11:32:47	11:32:29	11:32:25	11:32:03

Note: Data are n (%) or average time in the day.

Supplementary Table 4: Vaccination appointment booking rate within 72 hours for each trial arm - study 1.

Trial arm	Unadjusted booking rate within 72 hours (95% CI)	Adjusted OR (95% CI[1]), p-value	Adjusted percentage point difference (number of people)[2]
Control	23·02% (22·85-23·19%)	..	..
Simple	23·06% (22·88-23·23%)	1·00 (0·99-1·02), p = 0·8275	0·03 (63)
Reserved	23·23% (23·05-23·4%)	1·01 (1-1·03), p = 0·2345	0·21 (473)
Top of queue	23·5% (23·33-23·68%)	1·03 (1·01-1·04), p = 0·0026	0·45 (1028)
Join the millions	22·76% (22·59-22·93%)	0·98 (0·97-1), p = 0·0951	-0·28 (-636)
Convenience	23·18% (23·01-23·35%)	1·01 (0·99-1·02), p = 0·4381	0·15 (331)
Protection against virus	22·97% (22·8-23·14%)	1 (0·98-1·01), p = 0·8246	-0·07 (-155)
Protect you and...	23% (22·83-23·18%)	1 (0·98-1·01), p = 0·8275	-0·04 (-91)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message.*

Supplementary Table 5: Vaccination rate within 14 days for each trial arm - study 1.

Trial arm	Unadjusted vaccination rate within 14 days (95% CI)	Adjusted OR (95% CI[1]), p-value	Adjusted percentage point difference (number of people)[2]
Control	27·31% (27·13-27·49%)	..	..
Simple	27·38% (27·2-27·56%)	1 (0·99-1·02), p = 0·826	0·06 (127)
Reserved	27·46% (27·28-27·64%)	1·01 (0·99-1·02), p = 0·4666	0·15 (338)
Top of queue	27·72% (27·54-27·91%)	1·02 (1·01-1·03), p = 0·0353	0·38 (857)
Join the millions	27·15% (26·97-27·34%)	0·99 (0·98-1), p = 0·461	-0·17 (-393)
Convenience	27·62% (27·44-27·81%)	1·02 (1-1·03), p = 0·0877	0·30 (684)
Protection against virus	27·38% (27·2-27·56%)	1 (0·99-1·02), p = 0·826	0·05 (114)
Protect you and...	27·34% (27·16-27·52%)	1 (0·99-1·01), p = 0·9819	0 (7)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message.*

Supplementary Table 6: vaccination appointment booking rate within 72 hours for each trial arm and ethnic subgroup - study 1.

Trial arm ↓	Ethnic group →	White	Unknown	Other White	Pakistani, Bangladeshi, Other Asian	Indian, White & Asian, Other Mixed	Black, Mixed White & Black	Other
	(Group as a % of study population)	(47·33%)	(17·07%)	(14·70%)	(6·17%)	(5·16%)	(4·87%)	(4·71%)
Control	Unadj. booking rate % (95% CI)	29·07% (28·8-29·34%)	19·99% (19·6-20·39%)	18·59% (18·18-19·01%)	13·02% (12·48-13·58%)	20·98% (20·26-21·72%)	8·57% (8·06-9·11%)	17·54% (16·84-18·27%)
	Adj. OR (95% CI[1])	..	..	..	..	..	..	..
	p-value (pp difference)[2]	..	..	..	..	..	..	..
Simple	Unadj. booking rate % (95% CI)	29·11% (28·84-29·38%)	19·7% (19·3-20·1%)	18·9% (18·48-19·32%)	13·37% (12·82-13·94%)	20·57% (19·85-21·31%)	8·44% (7·94-8·97%)	17·98% (17·27-18·72%)
	Adj. OR (95% CI[1])	1·00 (0·98-1·02)	0·98 (0·95-1·02)	1·02 (0·98-1·06)	1·03 (0·96-1·11)	0·98 (0·92-1·04)	0·98 (0·89-1·08)	1·03 (0·96-1·11)
	p-value (pp difference)[2]	0·9078, (0·04)	0·3514, (-0·30)	0·9485, (0·30)	0·4392, (0·36)	0·7699, (-0·40)	0·9731, (-0·15)	0·7858, (0·46)
Reserved	Unadj. booking rate % (95% CI)	29·16% (28·89-29·43%)	20·44% (20·04-20·84%)	18·85% (18·43-19·27%)	13·67% (13·11-14·24%)	20·67% (19·95-21·41%)	9·26% (8·74-9·82%)	17·38% (16·68-18·11%)
	Adj. OR (95% CI[1])	1·00 (0·99-1·02)	1·03 (0·99-1·06)	1·02 (0·98-1·06)	1·06 (0·99-1·13)	0·98 (0·92-1·04)	1·09 (0·99-1·19)	0·99 (0·92-1·06)
	p-value (pp difference)[2]	0·9078, (0·08)	0·3242, (0·45)	0·9485, (0·25)	0·3087, (0·65)	0·7699, (-0·32)	0·4966, (0·69)	0·7858, (-0·17)
Top of queue	Unadj. booking rate % (95% CI)	29·63% (29·36-29·91%)	20·39% (19·99-20·79%)	19·06% (18·64-19·49%)	13·79% (13·22-14·37%)	20·46% (19·74-21·19%)	8·94% (8·42-9·48%)	17·69% (16·98-18·42%)
	Adj. OR (95% CI[1])	1·03 (1·01-1·05)	1·02 (0·99-1·06)	1·03 (0·99-1·07)	1·07 (1-1·14)	0·97 (0·91-1·03)	1·05 (0·95-1·15),	1·01 (0·94-1·08)
	p-value (pp difference)[2]	0·0335, (0·55)	0·3242, (0·39)	0·8399, (0·47)	0·3087, (0·77)	0·7699, (-0·54)	0·9731, (0·35)	0·7858, (0·14)
Join the millions	Unadj. booking rate % (95% CI)	28·76% (28·49-29·03%)	19·41% (19·02-19·8%)	18·57% (18·16-18·99%)	13% (12·46-13·56%)	20·48% (19·75-21·22%)	8·49% (7·98-9·02%)	17·83% (17·12-18·57%)
	Adj. OR (95% CI[1])	0·98 (0·97-1)	0·96 (0·93-1)	1·00 (0·96-1·04)	1·00 (0·93-1·07)	0·97 (0·91-1·03)	0·99 (0·9-1·09)	1·02 (0·95-1·1)
	p-value (pp difference)[2]	0·366, (-0·32)	0·2706, (-0·59)	0·9485, (-0·04)	0·9637, (-0·02)	0·7699, (-0·48)	0·9735, (-0·08)	0·7858, (0·32)
Convenience	Unadj. booking rate % (95% CI)	29·27% (29-29·54%)	20·06% (19·67-20·46%)	18·49% (18·08-18·92%)	13·62% (13·07-14·2%)	20·92% (20·19-21·66%)	8·32% (7·82-8·84%)	18·16% (17·44-18·89%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	1·00 (0·97-1·04)	0·99 (0·96-1·03)	1·05 (0·98-1·13)	1·00 (0·94-1·06)	0·97 (0·88-1·06)	1·04 (0·97-1·12)
	p-value (pp difference)[2]	0·7377, (0·2)	0·7916, (0·08)	0·9485, (-0·1)	0·3087, (0·6)	0·9908, (-0·04)	0·9731, (-0·26)	0·7858, (0·61)
Protection against virus	Unadj. booking rate % (95% CI)	29·05% (28·78-29·32%)	19·61% (19·22-20·01%)	18·42% (18·01-18·84%)	13·57% (13·01-14·15%)	20·96% (20·24-21·7%)	8·43% (7·92-8·96%)	17·73% (17·02-18·46%)
	Adj. OR (95% CI[1])	1 (0·98-1·02),	0·98 (0·94-1·01),	0·99 (0·95-1·03),	1·05 (0·98-1·12),	1 (0·94-1·06),	0·98 (0·89-1·08),	1·01 (0·94-1·09),
	p-value (pp difference)[2]	0·9078, (-0·02)	0·3242, (-0·38)	0·9485, (-0·18)	0·3087, (0·55)	0·9908, (-0·01)	0·9731, (-0·17)	0·7858, (0·18)

Protect you and...	Unadj. booking rate % (95% CI)	29·04% (28·77-29·31%)	19·68% (19·29-20·08%)	18·62% (18·21-19·04%)	13·49% (12·93-14·07%)	20·26% (19·54-21·01%)	8·6% (8·09-9·14%)	18·37% (17·65-19·12%)
	Adj. OR (95% CI[1])	1·00 (0·98-1·02)	0·98 (0·95-1·02)	1·00 (0·96-1·04)	1·04 (0·97-1·12)	0·96 (0·9-1·02)	1·00 (0·91-1·1)	1·06 (0·99-1·13)
	p-value (pp difference)[2]	0·9078, (-0·04)	0·3514, (-0·32)	0·9485, (0·02)	0·3386, (0·47)	0·7699, (-0·7)	0·9795, (0·01)	0·7768, (0·83)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup.*

Supplementary Table 7: vaccination rate within 14 days for each trial arm and ethnic group - study 1.

Trial arm ↓	Ethnic group →	White	Unknown	Other White	Pakistani, Bangladeshi, Other Asian	Indian, White & Asian, Other Mixed	Black, Mixed White & Black	Other
	(Group as a % of study population)	(47·33%)	(17·07%)	(14·70%)	(6·17%)	(5·16%)	(4·87%)	(4·71%)
Control	Unadj. vaccination rate % (95% CI)	34·01% (33·73-34·29%)	24·59% (24·16-25·02%)	21·31% (20·88-21·75%)	16·7% (16·1-17·32%)	25·29% (24·51-26·08%)	11·17% (10·59-11·77%)	21·66% (20·89-22·44%)
	Adj. OR (95% CI[1])	..	..	..	..	..	..	..
	p-value (pp difference)[2]	..	..	..	..	..	..	..
Simple	Unadj. vaccination rate % (95% CI)	34·04% (33·76-34·32%)	24·45% (24·03-24·88%)	21·88% (21·44-22·33%)	17·01% (16·4-17·64%)	24·88% (24·11-25·66%)	11·09% (10·52-11·68%)	21·47% (20·71-22·26%)
	Adj. OR (95% CI[1])	1·00 (0·98-1·02)	0·99 (0·96-1·03)	1·03 (1-1·07)	1·02 (0·96-1·09)	0·98 (0·92-1·04)	0·99 (0·91-1·08)	0·99 (0·93-1·06)
	p-value (pp difference)[2]	0·9553, (0·02)	0·7279, (-0·14)	0·1538, (0·54)	0·6966, (0·31)	0·9334, (-0·37)	0·8258, (-0·09)	0·9731, (-0·17)
Reserved	Unadj. vaccination rate % (95% CI)	33·9% (33·62-34·18%)	24·88% (24·45-25·31%)	21·97% (21·53-22·41%)	16·9% (16·29-17·52%)	25·37% (24·59-26·16%)	12·01% (11·42-12·63%)	21·58% (20·81-22·37%)
	Adj. OR (95% CI[1])	0·99 (0·98-1·01)	1·02 (0·98-1·05)	1·04 (1-1·08)	1·01 (0·95-1·08)	1 (0·95-1·07)	1·09 (1-1·18)	0·99 (0·93-1·06)
	p-value (pp difference)[2]	0·9553, (-0·11)	0·7279, (0·28)	0·1073, (0·63)	0·6966, (0·19)	0·9334, (0·09)	0·3315, (0·86)	0·9731, (-0·09)
Top of queue	Unadj. vaccination rate % (95% CI)	34·57% (34·29-34·85%)	24·71% (24·29-25·14%)	22·07% (21·63-22·52%)	16·9% (16·28-17·53%)	25·07% (24·3-25·85%)	11·38% (10·8-11·98%)	20·91% (20·15-21·69%)
	Adj. OR (95% CI[1])	1·02 (1·01-1·04)	1·01 (0·97-1·04)	1·05 (1·01-1·08)	1·01 (0·95-1·08)	0·99 (0·93-1·05)	1·02 (0·94-1·11)	0·96 (0·89-1·02)
	p-value (pp difference)[2]	0·0485, (0·55)	0·7279, (0·12)	0·0635, (0·75)	0·6966, (0·17)	0·9334, (-0·23)	0·8258, (0·21)	0·9731, (-0·77)
Join the millions	Unadj. booking rate % (95% CI)	33·91% (33·63-34·2%)	23·91% (23·49-24·33%)	21·73% (21·29-22·17%)	16·44% (15·84-17·06%)	24·72% (23·95-25·52%)	11·36% (10·78-11·96%)	21·05% (20·29-21·84%)
	Adj. OR (95% CI[1])	1·00 (0·98-1·01)	0·96 (0·93-1)	1·02 (0·99-1·06)	0·98 (0·92-1·04)	0·97 (0·92-1·03)	1·02 (0·94-1·11)	0·97 (0·9-1·03)
	p-value (pp difference)[2]	0·9553, (-0·1)	0·1769, (-0·69)	0·2998, (0·39)	0·6966, (-0·28)	0·9334, (-0·54)	0·8258, (0·2)	0·9731, (-0·6)
Convenience	Unadj. vaccination rate % (95% CI)	34·34% (34·06-34·63%)	24·69% (24·26-25·12%)	22·17% (21·73-22·62%)	16·95% (16·34-17·58%)	25·02% (24·25-25·81%)	10·95% (10·38-11·54%)	21·73% (20·97-22·52%)
	Adj. OR (95% CI[1])	1·01 (1-1·03)	1·01 (0·97-1·04)	1·05 (1·01-1·09)	1·02 (0·96-1·08)	0·99 (0·93-1·05)	0·98 (0·9-1·06)	1·00 (0·94-1·07)
	p-value (pp difference)[2]	0·3766, (0·33)	0·7279, (0·11)	0·0532, (0·85)	0·6966, (0·23)	0·9334, (-0·21)	0·8258, (-0·23)	0·9731, (0·05)
Protection against virus	Unadj. vaccination rate % (95% CI)	34·09% (33·81-34·37%)	24·45% (24·02-24·88%)	21·53% (21·09-21·97%)	17·07% (16·45-17·7%)	25·11% (24·34-25·9%)	11·07% (10·5-11·67%)	21·59% (20·82-22·37%)

	Adj. OR (95% CI[1])	1 (0·99-1·02)	0·99 (0·96-1·03)	1·01 (0·98-1·05)	1·03 (0·96-1·09)	0·99 (0·94-1·05)	0·99 (0·91-1·08)	1·00 (0·93-1·06)
	p-value (pp difference)[2]	0·9553, (0·08)	0·7279, (-0·14)	0·5156, (0·21)	0·6966, (0·35)	0·9334, (-0·16)	0·8258, (-0·11)	0·9731, (-0·08)
Protect you and...	Unadj. vaccination rate % (95% CI)	34·01% (33·73-34·29%)	24·31% (23·89-24·74%)	21·69% (21·26-22·14%)	16·94% (16·32-17·57%)	25·3% (24·52-26·1%)	10·95% (10·38-11·55%)	21·69% (20·92-22·47%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	0·98 (0·95-1·02)	1·02 (0·98-1·06)	1·02 (0·95-1·08)	1·00 (0·95-1·06)	0·98 (0·9-1·06)	1·00 (0·94-1·07)
	p-value (pp difference)[2]	0·9553, (-0·01)	0·7279, (-0·29)	0·2998, (0·36)	0·6966, (0·21)	0·9334, (0·05)	0·8258, (-0·24)	0·9731, (0·02)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup.*

Supplementary Table 8: vaccination appointment booking rate within 72 hours for each trial arm and sex - study 1.

Trial arm ↓	Sex → (Group as a % of study population)	Female (44·86%)	Male (55·14%)
Control	Unadj. booking rate % (95% CI)	23·26% (23·01 - 23·52%)	22·82% (22·59-23·05%)
	Adj. OR (95% CI[1])	..	..
	p-value (pp difference)[2]	..	..
Simple	Unadj. booking rate % (95% CI)	23·38% (23·12-23·64%)	22·79% (22·56-23·02%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	1 (0·98-1·02)
	p-value (pp difference)[2]	p = 0·8594, (0·11)	p = 0·9369, (-0·04)
Reserved	Unadj. booking rate % (95% CI)	23·21% (22·95-23·47%)	23·24% (23-23·47%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	1·02 (1-1·04)
	p-value (pp difference)[2]	p = 0·9328, (-0·05)	p = 0·0539, (0·41)
Top of queue	Unadj. booking rate % (95% CI)	23·72% (23·46-23·98%)	23·33% (23·1-23·56%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·03 (1·01-1·05)
	p-value (pp difference)[2]	p = 0·21, (0·41)	p = 0·0314, (0·48)
Join the millions	Unadj. booking rate % (95% CI)	23·03% (22·77-23·29%)	22·54% (22·31-22·77%)
	Adj. OR (95% CI[1])	0·98 (0·96-1·01)	0·98 (0·97-1)
	p-value (pp difference)[2]	p = 0·3461, (-0·27)	p = 0·2217, (-0·28)
Convenience	Unadj. booking rate % (95% CI)	23·57% (23·31-23·83%)	22·86% (22·63-23·09%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1 (0·98-1·02)
	p-value (pp difference)[2]	p = 0·3461, (0·31)	p = 0·9369, (0·01)
Protection against virus	Unadj. booking rate % (95% CI)	23·16% (22·91-23·42%)	22·82% (22·58-23·05%)
	Adj. OR (95% CI[1])	0·99 (0·97-1·02)	1 (0·98-1·02)
	p-value (pp difference)[2]	p = 0·8594, (-0·1)	p = 0·9369, (-0·05)
Protect you and···	Unadj. booking rate % (95% CI)	23·32% (23·06-23·58%)	22·74% (22·51-22·98%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	1 (0·98-1·01)
	p-value (pp difference)[2]	p = 0·9328, (0·02)	p = 0·9369, (-0·08)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure·*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup·*

Supplementary Table 9: Vaccination rate within 14 days for each trial arm and sex - study 1.

Trial arm ↓	Gender → (Group as a % of study population)	Female (44·86%)	Male (55·14%)
Control	Unadj. booking rate % (95% CI)	27·2% (26·93-27·48%)	27·39% (27·15-27·64%)
	Adj. OR (95% CI[1])	..	..
	p-value (pp difference)[2]	..	..
Simple	Unadj. booking rate % (95% CI)	27·47% (27·2-27·74%)	27·3% (27·06-27·55%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	0·99 (0·98-1·01)
	p-value (pp difference)[2]	p = 0·4616, (0·26)	p = 0·7743, (-0·11)
Reserved	Unadj. booking rate % (95% CI)	27·19% (26·92-27·46%)	27·68% (27·43-27·92%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	1·01 (1-1·03)
	p-value (pp difference)[2]	p = 0·9611, (-0·01)	p = 0·3092, (0·27)
Top of queue	Unadj. booking rate % (95% CI)	27·71% (27·44-27·99%)	27·73% (27·48-27·98%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·02 (1-1·03)
	p-value (pp difference)[2]	p = 0·1309, (0·47)	p = 0·3092, (0·3)
Join the millions	Unadj. booking rate % (95% CI)	27·2% (26·93-27·47%)	27·12% (26·87-27·36%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	0·99 (0·97-1)
	p-value (pp difference)[2]	p = 0·9611, (-0·04)	p = 0·3092, (-0·28)
Convenience	Unadj. booking rate % (95% CI)	27·62% (27·35-27·9%)	27·63% (27·38-27·87%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·01 (0·99-1·03)
	p-value (pp difference)[2]	p = 0·1319, (0·42)	p = 0·4438, (0·21)
Protection against virus	Unadj. booking rate % (95% CI)	27·34% (27·06-27·61%)	27·42% (27·17-27·66%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	1 (0·98-1·02),
	p-value (pp difference)[2]	p = 0·8091, (0·15)	p = 0·8621, (-0·03)
Protect you and···	Unadj. booking rate % (95% CI)	27·34% (27·06-27·61%)	27·34% (27·1-27·59%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	1 (0·98-1·01)
	p-value (pp difference)[2]	p = 0·9075, (0·09)	p = 0·8253, (-0·07)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure·*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup·*

Supplementary Table 10: Baseline characteristics by treatment allocation - study 2.

	Control	Top of queue	Convenience	Reserved	Top + Convenience	Reserved + Convenience	Front
Age (years)							
24	14923 (4·8%)	14776 (4·79%)	14827 (4·76%)	15048 (4·85%)	14894 (4·8%)	14867 (4·78%)	14913 (4·8%)
25	59534 (19·17%)	59426 (19·25%)	59660 (19·13%)	59968 (19·33%)	59775 (19·25%)	59907 (19·25%)	59311 (19·08%)
26	59294 (19·09%)	59163 (19·16%)	59667 (19·14%)	59434 (19·16%)	59084 (19·02%)	59380 (19·08%)	59432 (19·11%)
27	61209 (19·71%)	60715 (19·67%)	61360 (19·68%)	61682 (19·88%)	61443 (19·78%)	61348 (19·72%)	61403 (19·75%)
28	64260 (20·69%)	63708 (20·64%)	64816 (20·79%)	63656 (20·52%)	64422 (20·74%)	64306 (20·67%)	64596 (20·78%)
29	51370 (16·54%)	50923 (16·5%)	51478 (16·51%)	50479 (16·27%)	50973 (16·41%)	51363 (16·51%)	51271 (16·49%)
Sex							
Female	155546 (50·08%)	155201 (50·27%)	156542 (50·2%)	155452 (50·1%)	154788 (49·84%)	155884 (50·1%)	155775 (50·1%)
Male	155025 (49·91%)	153484 (49·72%)	155244 (49·79%)	154793 (49·89%)	155776 (50·15%)	155259 (49·9%)	155131 (49·89%)
Unknown	19 (0·01%)	26 (0·01%)	22 (0·01%)	22 (0·01%)	27 (0·01%)	28 (0·01%)	20 (0·01%)
Ethnic group							
White	147945 (47·63%)	147301 (47·71%)	149104 (47·82%)	147765 (47·63%)	147996 (47·65%)	148072 (47·59%)	148079 (47·63%)
Indian, White & Asian, Other Mixed	13246 (4·26%)	13248 (4·29%)	13380 (4·29%)	13420 (4·33%)	13288 (4·28%)	13300 (4·27%)	13586 (4·37%)
Black, Mixed White & Black	16877 (5·43%)	16447 (5·33%)	16788 (5·38%)	16579 (5·34%)	16706 (5·38%)	16533 (5·31%)	16591 (5·34%)
Unknown	53897 (17·35%)	53643 (17·38%)	53651 (17·21%)	53738 (17·32%)	53804 (17·32%)	53975 (17·35%)	54051 (17·38%)
Other	20632 (6·64%)	20147 (6·53%)	20580 (6·6%)	20549 (6·62%)	20468 (6·59%)	20571 (6·61%)	20577 (6·62%)
Other White	39396 (12·68%)	39391 (12·76%)	39605 (12·7%)	39809 (12·83%)	39699 (12·78%)	40149 (12·9%)	39539 (12·72%)
Pakistani, Bangladeshi, Other Asian	18597 (5·99%)	18534 (6%)	18700 (6%)	18407 (5·93%)	18630 (6%)	18571 (5·97%)	18503 (5·95%)
Day of week message sent							
Tuesday	67501 (21·73%)	66855 (21·66%)	67904 (21·78%)	66314 (21·37%)	67142 (21·62%)	67504 (21·69%)	67449 (21·69%)
Wednesday	62959 (20·27%)	62338 (20·19%)	63142 (20·25%)	62886 (20·27%)	63206 (20·35%)	63013 (20·25%)	63220 (20·33%)

Thursday	60899 (19·61%)	60832 (19·71%)	61404 (19·69%)	61346 (19·77%)	61105 (19·67%)	61348 (19·72%)	61458 (19·77%)
Friday	59654 (19·21%)	59042 (19·13%)	59386 (19·05%)	59263 (19·1%)	59113 (19·03%)	59069 (18·98%)	59020 (18·98%)
Saturday	59577 (19·18%)	59644 (19·32%)	59972 (19·23%)	60458 (19·49%)	60025 (19·33%)	60237 (19·36%)	59779 (19·23%)
Time message sent (hours, minutes, seconds; GMT+01)							
Average time sent	11:54:41	11:55:28	11:55:00	11:54:42	11:55:02	11:55:22	11:54:35
Note: Data are n (%) or average time in the day.							

Supplementary Table 11: Vaccination appointment booking rate within 72 hours for each trial arm - study 2·

Trial arm	Unadjusted booking rate within 72 hours (95% CI)	Adjusted OR (95% CI[1]), p-value	Adjusted percentage point difference (number of people)[2]
Control	12·68% (12·56-12·79%)	..	..
Top of queue	13·26% (13·14-13·38%)	1·05 (1·04-1·07), p < 0·001	0·60 (1841)
Convenience	12·78% (12·66-12·9%)	1·01 (0·99-1·02), p = 0·2700	0·09 (293)
Reserved	12·78% (12·67-12·9%)	1·01 (1-1·03), p = 0·1539	0·13 (404)
Top of queue + Convenience	13·34% (13·22-13·46%)	1·06 (1·05-1·08), p < 0·001	0·68 (2105)
Reserved + Convenience	12·87% (12·75-12·98%)	1·02 (1-1·03), p = 0·0307	0·20 (617)
Front	13·11% (12·99-13·22%)	1·04 (1·02-1·05), p < 0·001	0·43 (1340)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message.*

Supplementary Table 12: Vaccination rate within 14 days for each trial arm - study 2.

Trial arm	Unadjusted vaccination rate within 14 days (95% CI)	Adjusted OR (95% CI[1]), p-value	Adjusted percentage point difference (number of people)[2]
Control	23·68% (23·52-23·83%)	..	..
Top of queue	24·1% (23·94-24·25%)	1·02 (1·01-1·04), p < 0·001	0·41 (1219)
Convenience	23·77% (23·62-23·93%)	1 (0·99-1·02), p = 0·5351	0·07 (210)
Reserved	23·74% (23·59-23·9%)	1 (0·99-1·02), p = 0·5351	0·07 (207)
Top of queue + Convenience	24·17% (24·02-24·32%)	1·03 (1·02-1·04), p < 0·001	0·50 (1499)
Reserved + Convenience	23·89% (23·74-24·04%)	1·01 (1-1·02), p = 0·0785	0·22 (650)
Front	24·05% (23·89-24·2%)	1·02 (1·01-1·03), p = 0·0028	0·36 (1070)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message.*

Supplementary Table 13: Vaccination appointment booking rate within 72 hours for each trial arm and ethnic subgroup - study 2.

Trial arm ↓	Ethnic group →	White	Unknown	Other White	Other	Pakistani, Bangladeshi, Other Asian	Black, Mixed White & Black	Indian, White & Asian, Other Mixed
	(Group as a % of study population)	(47·66%)	(17·33%)	(12·77%)	(6·60%)	(5·98%)	(5·36%)	(4·30%)
Control	Unadj. booking rate % (95% CI)	16·4% (16·21-16·59%)	10·72% (10·46-10·99%)	9·39% (9·11-9·68%)	7·12% (6·78-7·48%)	8·66% (8·27-9·08%)	5·52% (5·18-5·87%)	12·25% (11·7-12·81%)
	Adj. OR (95% CI[1])	..	..	..	..	..	..	..
	p-value (pp difference)[2]	..	..	..	..	..	..	..
Top	Unadj. booking rate % (95% CI)	17·16% (16·97-17·36%)	11·6% (11·34-11·88%)	9·62% (9·34-9·92%)	7·27% (6·92-7·63%)	8·76% (8·36-9·18%)	5·67% (5·33-6·04%)	12·27% (11·72-12·84%)
	Adj. OR (95% CI[1])	1·06 (1·04-1·08)	1·1 (1·05-1·14)	1·03 (0·98-1·08)	1·02 (0·95-1·1)	1·01 (0·94-1·09)	1·03 (0·94-1·13)	1 (0·93-1·08)
	p-value (pp difference)[2]	p < 0·001, (0·79)	p < 0·001, (0·9)	p = 0·4142, (0·23)	p = 0·581, (0·14)	p = 0·7474, (0·09)	p = 0·8559, (0·17)	p = 0·9552, (0·04)
Convenience	Unadj. booking rate % (95% CI)	16·6% (16·42-16·79%)	10·79% (10·53-11·05%)	9·12% (8·84-9·41%)	7·33% (6·98-7·69%)	8·88% (8·48-9·3%)	5·41% (5·08-5·76%)	12·11% (11·57-12·67%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·01 (0·97-1·05)	0·97 (0·92-1·01)	1·03 (0·95-1·11)	1·03 (0·96-1·1)	0·98 (0·89-1·07)	0·98 (0·91-1·06)
	p-value (pp difference)[2]	p = 0·1345, (0·22)	p = 0·6532, (0·09)	p = 0·4142, (-0·28)	p = 0·581, (0·17)	p = 0·7244, (0·22)	p = 0·8559, (-0·12)	p = 0·9552, (-0·16)
Reserved	Unadj. booking rate % (95% CI)	16·64% (16·45-16·83%)	10·92% (10·66-11·19%)	9·25% (8·97-9·54%)	6·79% (6·46-7·15%)	8·94% (8·54-9·36%)	5·3% (4·97-5·65%)	11·97% (11·43-12·53%)
	Adj. OR (95% CI[1])	1·02 (1-01·04)	1·02 (0·98-1·06)	0·99 (0·94-1·03)	0·95 (0·88-1·03)	1·04 (0·96-1·11)	0·96 (0·87-1·06)	0·98 (0·91-1·05)
	p-value (pp difference)[2]	p = 0·0635, (0·28)	p = 0·2922, (0·22)	p = 0·6593, (-0·12)	p = 0·5373, (-0·31)	p = 0·7244, (0·28)	p = 0·8559, (-0·21)	p = 0·9552, (-0·27)
Top + Convenience	Unadj. booking rate % (95% CI)	17·3% (17·11-17·5%)	11·44% (11·18-11·71%)	9·62% (9·33-9·91%)	7·58% (7·23-7·95%)	9·24% (8·83-9·66%)	5·61% (5·28-5·97%)	12·28% (11·73-12·85%)
	Adj. OR (95% CI[1])	1·07 (1·05-1·09)	1·08 (1·04-1·12)	1·03 (0·98-1·08)	1·06 (0·98-1·14)	1·07 (1-1·15)	1·02 (0·93-1·12)	1 (0·93-1·08)
	p-value (pp difference)[2]	p = p < 0·001, (0·93)	p < 0·001, (0·72)	p = 0·4142, (0·23)	p = 0·5373, (0·38)	p = 0·3016, (0·58)	p = 0·8559, (0·09)	p = 0·9552, (0·02)
Reserved + Convenience	Unadj. booking rate % (95% CI)	16·56% (16·37-16·75%)	11·17% (10·91-11·44%)	9·43% (9·15-9·72%)	7·34% (6·99-7·7%)	8·83% (8·43-9·24%)	5·22% (4·89-5·57%)	12·74% (12·19-13·32%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	1·05 (1·01-1·09)	1 (0·96-1·05)	1·03 (0·96-1·11)	1·02 (0·95-1·1)	0·94 (0·86-1·04)	1·05 (0·97-1·12)

	p-value (pp difference)[2]	p = 0·1946, (0·18)	p = 0·0339, (0·46)	p = 0·8526, (0·04)	p = 0·581, (0·21)	p = 0·7244, (0·15)	p = 0·8559, (-0·29)	p = 0·6858, (0·49)
Front	Unadj. booking rate % (95% CI)	16·97% (16·78-17·16%)	10·96% (10·7-11·22%)	9·79% (9·5-10·09%)	7·43% (7·08-7·8%)	8·89% (8·48-9·3%)	5·49% (5·15-5·85%)	12·8% (12·25-13·37%)
	Adj. OR (95% CI[1])	1·04 (1·02-1·06)	1·03 (0·99-1·07)	1·05 (1-1·1)	1·04 (0·97-1·12)	1·03 (0·95-1·1)	0·99 (0·91-1·09)	1·05 (0·97-1·13)
	p-value (pp difference)[2]	p < 0·001, (0·58)	p = 0·2872, (0·25)	p = 0·2903, (0·41)	p = 0·5373, (0·28)	p = 0·7244, (0·2)	p = 0·9083, (-0·03)	p = 0·6858, (0·51)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure·*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup.*

Supplementary Table 14: Vaccination rate within 14 days for each trial arm and ethnic group - study 2.

Trial arm ↓	Ethnic group →	White	Unknown	Other White	Other	Pakistani, Bangladeshi, Other Asian	Black, Mixed White & Black	Indian, White & Asian, Other Mixed
	(Group as a % of study population)	(47·66%)	(17·33%)	(12·77%)	(6·60%)	(5·98%)	(5·36%)	(4·30%)
Control	Unadj. vaccination rate % (95% CI)	30.95% (30.71-31.19%)	19.8% (19.46-20.14%)	16.01% (15.64-16.38%)	12.54% (12.09-13.01%)	18.7% (18.14-19.27%)	10.98% (10.51-11.46%)	23.84% (23.11-24.59%)
	Adj. OR (95% CI[1])	..	..	..	..	..	..	..
	p-value (pp difference)[2]	..	..	..	..	..	..	..
Top	Unadj. vaccination rate % (95% CI)	31·42% (31·18-31·67%)	20·4% (20·06-20·75%)	16·3% (15·94-16·68%)	12·63% (12·18-13·1%)	18·18% (17·62-18·75%)	11·26% (10·78-11·76%)	24·64% (23·9-25·4%)
	Adj. OR (95% CI[1])	1·06 (1·04-1·08)	1·1 (1·05-1·14)	1·03 (0·98-1·08)	1·02 (0·95-1·1)	1·01 (0·94-1·09)	1·03 (0·94-1·13)	1 (0·93-1·08)
	p-value (pp difference)[2]	p < 0·001, (1·23)	p < 0·001, (1·48)	p = 0·4142, (0·36)	p = 0·581, (0·23)	p = 0·7474, (0·18)	p = 0·8559, (0·31)	p = 0·9552, (0·07)
Convenience	Unadj. vaccination rate % (95% CI)	31·06% (30·82-31·3%)	19·74% (19·4-20·08%)	15·92% (15·56-16·29%)	12·97% (12·51-13·44%)	19·48% (18·91-20·06%)	10·58% (10·12-11·06%)	23·38% (22·66-24·13%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·01 (0·97-1·05)	0·97 (0·92-1·01)	1·03 (0·95-1·11)	1·03 (0·96-1·1)	0·98 (0·89-1·07)	0·98 (0·91-1·06)
	p-value (pp difference)[2]	p = 0·1345, (0·34)	p = 0·6532, (0·14)	p = 0·4142, (-0·45)	p = 0·581, (0·29)	p = 0·7244, (0·42)	p = 0·8559, (-0·23)	p = 0·9552, (-0·28)
Reserved	Unadj. vaccination rate % (95% CI)	31·19% (30·95-31·43%)	19·59% (19·26-19·94%)	15·93% (15·57-16·3%)	12·6% (12·15-13·07%)	18·93% (18·37-19·52%)	10·72% (10·25-11·2%)	23·46% (22·74-24·2%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·02 (0·98-1·06)	0·99 (0·94-1·03)	0·95 (0·88-1·03)	1·04 (0·96-1·11)	0·96 (0·87-1·06)	0·98 (0·91-1·05)
	p-value (pp difference)[2]	p = 0·0635, (0·43)	p = 0·2922, (0·37)	p = 0·6593, (-0·2)	p = 0·5373, (-0·52)	p = 0·7244, (0·53)	p = 0·8559, (-0·39)	p = 0·9552, (-0·45)
Top + Convenience	Unadj. vaccination rate % (95% CI)	31·62% (31·38-31·87%)	20·63% (20·28-20·98%)	16·06% (15·7-16·43%)	13·28% (12·82-13·76%)	19·35% (18·78-19·93%)	10·31% (9·86-10·79%)	23·02% (22·3-23·76%)
	Adj. OR (95% CI[1])	1·07 (1·05-1·09)	1·08 (1·04-1·12)	1·03 (0·98-1·08)	1·06 (0·98-1·14)	1·07 (1-1·15)	1·02 (0·93-1·12)	1 (0·93-1·08)
	p-value (pp difference)[2]	p < 0·001, (1·44)	p < 0·001, (1·19)	p = 0·4142, (0·37)	p = 0·5373, (0·63)	p = 0·3016, (1·11)	p = 0·8559, (0·17)	p = 0·9552, (0·04)
Reserved + Convenience	Unadj. vaccination rate % (95% CI)	31·12% (30·87-31·36%)	20·05% (19·71-20·4%)	16·28% (15·91-16·65%)	13·01% (12·55-13·48%)	19·3% (18·73-19·88%)	10·31% (9·85-10·78%)	24·27% (23·53-25·03%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	1·05 (1·01-1·09)	1 (0·96-1·05)	1·03 (0·96-1·11)	1·02 (0·95-1·1)	0·94 (0·86-1·04)	1·05 (0·97-1·12)

	p-value (pp difference)[2]	p = 0·1946, (0·28)	p = 0·0339, (0·75)	p = 0·8526, (0·06)	p = 0·581, (0·34)	p = 0·7244, (0·29)	p = 0·8559, (-0·55)	p = 0·6858, (0·82)
Front	Unadj. vaccination rate % (95% CI)	31·53% (31·29-31·77%)	19·89% (19·55-20·24%)	16·18% (15·82-16·55%)	13·33% (12·87-13·81%)	18·98% (18·41-19·56%)	10·63% (10·16-11·11%)	23·46% (22·74-24·19%)
	Adj. OR (95% CI[1])	1·04 (1·02-1·06)	1·03 (0·99-1·07)	1·05 (1-1·1)	1·04 (0·97-1·12)	1·03 (0·95-1·1)	0·99 (0·91-1·09)	1·05 (0·97-1·13)
	p-value (pp difference)[2]	p < 0·001, (0·9)	p = 0·2872, (0·41)	p = 0·2903, (0·65)	p = 0·5373, (0·47)	p = 0·7244, (0·39)	p = 0·9083, (-0·05)	p = 0·6858, (0·86)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure.*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup.*

Supplementary Table 15: Vaccination appointment booking rate rate within 72 hours for each trial arm and sex - study 2

Trial arm ↓	sex → (Group as a % of study population)	Female (50·10%)	Male (49·89%)
Control	Unadj. booking rate % (95% CI)	12·20% (12·04-12·37%)	13·15% (12·98-13·32%)
	Adj. OR (95% CI[1])	..	..
	p-value (pp difference)[2]	..	..
Top	Unadj. booking rate % (95% CI)	12·59% (12·42-12·75%)	13·94% (13·77-14·12%)
	Adj. OR (95% CI[1])	1·04 (1·01-1·06)	1·07 (1·05-1·09)
	p-value (pp difference)[2]	p = 0·0035, (0·39)	p < 0·001, (0·81)
Convenience	Unadj. booking rate % (95% CI)	12·17% (12·01-12·34%)	13·39% (13·22-13·56%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	1·02 (1-1·04)
	p-value (pp difference)[2]	p = 0·7845, (-0·03)	p = 0·0725, (0·22)
Reserved	Unadj. booking rate % (95% CI)	12·22% (12·06-12·38%)	13·35% (13·18-13·52%)
	Adj. OR (95% CI[1])	1 (0·98-1·03)	1·02 (1-1·04)
	p-value (pp difference)[2]	p = 0·7845, (0·03)	p = 0·0725, (0·23)
Top + Convenience	Unadj. booking rate % (95% CI)	12·63% (12·47-12·8%)	14·03% (13·86-14·21%)
	Adj. OR (95% CI[1])	1·04 (1·02-1·07)	1·08 (1·06-1·1)
	p-value (pp difference)[2]	p < 0·001, (0·46)	p < 0·001, (0·9)
Reserved + Convenience	Unadj. booking rate % (95% CI)	12·37% (12·21-12·54%)	13·36% (13·19-13·53%)
	Adj. OR (95% CI[1])	1·02 (0·99-1·04)	1·02 (1-1·04)
	p-value (pp difference)[2]	p = 0·2196, (0·17)	p = 0·0725, (0·22)
Front	Unadj. booking rate % (95% CI)	12·48% (12·32-12·65%)	13·73% (13·56-13·9%)
	Adj. OR (95% CI[1])	1·03 (1·01-1·05)	1·05 (1·03-1·07)
	p-value (pp difference)[2]	p = 0·0265, (0·3)	p < 0·0001, (0·57)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure·*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup·*

Supplementary Table 16: Vaccination rate within 14 days for each trial arm and sex - study 2.

Trial arm ↓	Gender → (Group as a % of study population)	Female (50·10%)	Male (49·89%)
Control	Unadj. vaccination rate % (95% CI)	22·73% (22·52-22·95%)	24·62% (24·4-24·84%)
	Adj. OR (95% CI[1])		
	p-value (pp difference)[2]		
Top	Unadj. vaccination rate % (95% CI)	23·10% (22·89-23·32%)	25·10% (24·88-25·32%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·03 (1·01-1·04)
	p-value (pp difference)[2]	p = 0·0653, (0·36)	p = 0·0121, (0·46)
Convenience	Unadj. vaccination rate % (95% CI)	22·69% (22·48-22·9%)	24·86% (24·65-25·08%)
	Adj. OR (95% CI[1])	1 (0·98-1·02)	1·01 (0·99-1·03)
	p-value (pp difference)[2]	p = 0·7923, (-0·04)	p = 0313, (0·18))
Reserved	Unadj. vaccination rate % (95% CI)	22·83% (22·62-23·05%)	24·66% (24·44-24·87%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·02)	1 (0·99-1·02)
	p-value (pp difference)[2]	p = 0·597, (0·11)	p = 0·8254, (0·04)
Top + Convenience	Unadj. vaccination rate % (95% CI)	23·05% (22·84-23·27%)	25·28% (25·06-25·50%)
	Adj. OR (95% CI[1])	1·02 (1-1·04)	1·04 (1·02-1·05)
	p-value (pp difference)[2]	p = 0·0653, (0·36)	p < 0·001, (0·65)
Reserved + Convenience	Unadj. vaccination rate % (95% CI)	22·91% (22·7-23·12%)	24·87% (24·65-25·09%)
	Adj. OR (95% CI[1])	1·01 (0·99-1·03)	1·01 (1-1·03)
	p-value (pp difference)[2]	p = 0·3038, (0·20)	p = 0-2228, (0·23)
Front	Unadj. vaccination rate % (95% CI)	22·99% (22·77-23·20%)	25·1% (24·88-25·32%)
	Adj. OR (95% CI[1])	1·02 (1-1·03)	1·02 (1·01-1·04)
	p-value (pp difference)[2]	p = 0·1402, (0·28)	p = 0·0155, (0·43)

1. *95% CIs around ORs are not adjusted for multiple comparisons, whereas p-values are adjusted within each subgroup using the Benjamini-Hochberg procedure·*
2. *Adjusted OR, p-value of difference, percentage point difference, and number of people relative to the "Control" message in each subgroup·*