Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.
eAppendix 1. Moderation Analyses

All baseline characteristics described in Table 1 were examined as potential moderators of the treatment effect on our primary outcome (30-day ITT abstinence rates at 7-month follow-up), one moderator at a time. Logistic regression models were fit that included main effects of treatment arm, baseline values of the moderator, and treatment by moderator interactions. Logistic regression coefficients (betas) corresponding to the interaction term, their standard errors and p-values are reported in eTable 2.

As the assessment-only control was used as the reference group in these analyses, betas represent treatment vs. control arm differences in the log-odds of abstinence per unit change in the moderator. This interpretation holds for both continuous and binary (0/1) moderators. For multi-category moderators, betas correspond to treatment vs. control arm differences in the log-odds of abstinence between the target and reference category of the moderator, e.g., in differences between Black vs. white racial categories.
**eAppendix 2: Multiple Imputation Approach**

We evaluated the sensitivity of our intent-to-treat (ITT) findings to the “missing = vaping” assumption using the multiple imputation (MI) approach of Hedeker et al.\(^1\) which has been further evaluated and refined by others.\(^2\)-\(^4\) This approach is driven by the observation that in any 2x2 table that stratifies missing outcomes (yes/no) by vaping status (yes/no), the odds of vaping among non-respondents can be imputed by first estimating the odds of vaping among respondents and then multiplying them by the odds ratio capturing the association between missingness and vaping (OR.miss). The stronger the odds ratio, the more likely that the missing outcomes represent vaping. Conversely, the weaker the odds ratio, the more likely that the missing data represent abstinence. Two important cases occur when (a) OR.miss=1, i.e., there is no association between missingness and vaping outcome, and (b) OR.miss=\(+\infty\), in which case missing outcomes are certain to represent vaping. The first case corresponds to a Missing-at-Random (MAR) scenario, as defined by Little and Rubin\(^5\) whereas the second case reduces to the ITT assumption. Of note, all OR.miss values other than 1 represent a non-ignorable missingness mechanism (NMAR), whose validity cannot actually be tested from the available data. For that reason, it is common to vary OR.miss over a large range (symmetric around 1 in the logarithmic scale) and to evaluate the sensitivity of the findings to the model assumptions.

To the extent that the odds of vaping among respondents are themselves a random variable subject to estimation uncertainty, multiple imputation is needed to fully propagate this uncertainty to the standard errors of the parameters of interest. In building an imputation model, it is worth noting that outcome missingness is allowed to depend on observed data under a MAR assumption. To make the MAR assumption more plausible, it is, therefore, typical to incorporate in the imputation model information from the baseline variables that have little missing data of their own. Following Hedeker\(^1\) and Smolkowski\(^2\), we chose to enrich our imputation model by estimating the odds of abstinence among respondents separately by nicotine dependence levels at baseline (vape within 30 minutes after waking vs. not). We also evaluated the strength of the (untestable) model assumptions by noting the extent to which it reduces the fraction of missing information (FMI) in the parameter of interest: the odds ratio capturing the association between the

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text messaging intervention and vaping outcome (OR.vape). Under a complete case analyses (CCA), the observed missingness rate at 7-month follow-up was 24%, whereas ITT reduces this to zero by setting all missing outcomes to vaping (OR.miss=+∞). Therefore, we would expect finite values of OR.miss to reduce the FMI from 24% towards zero as they depart from the MAR value (OR.miss=1). The FMI is typically unknown, but can be estimated as the ratio of the between-imputation variance to the total variance of the parameter of interest, as the between imputation variance is zero in a scenario with no missing data. To improve the accuracy of the FMI estimate, we used M=10,000 imputations for each value of OR.miss in our sensitivity analyses.

The MI findings are shown in eTable 2 as we varied OR.miss in a fashion symmetric around 1 in the logarithmic scale in a manner non-differential across study arms. As OR.miss increased from 1/100 to 100, the abstinence rates in the control (P0) and intervention (P1) arms both decreased towards their ITT estimates, with the difference shrinking monotonically from P1-P0 = 8.29% to 5.39%, indicating a smaller treatment effect as more non-respondents were classified as vapers. In contrast, using relative risk instead of risk difference as our preferred metric, increases in OR.miss led to an increase in the estimate of the treatment effect from P1/P0 = 1.20 to 1.29 at their ITT limit. Finally, use of an odds ratio scale showed intervention effects broadly symmetric around the MAR model, with OR.vape = [P1/(1-P1)]/(P0/(1-P0)) = 1.38-1.40 varying across a quite narrow range close to the ITT estimate of 1.39. Despite these differences, all 3 metrics resulted in positive and very highly significant estimates of the treatment effect. For robustness reasons, we chose to highlight the OR findings in the abstract. Regarding the FMI estimates, we note that they approach zero at both ends of the range (1/100, 100), indicating that more extreme values of OR.miss need not be explored. Indeed, the estimates at OR.miss=100 are indistinguishable from the ITT estimates. As for a Complete Case Analyses (CCA) that used treatment arm as the sole predictor of outcome, the estimated abstinence proportions appear to lie between imputation models that treat non-responders as 4/5-5/4 as likely to be vapers than abstainers.
### eTable 1. Comparison of Baseline Characteristics Between Non-Responders and Responders at 7-Month Follow-Up

|                          | Total        | Non-Responder | Responder    | P-Val | SMD  |
|--------------------------|--------------|---------------|--------------|-------|------|
|                          | N=2,588      | N=621         | N=1,967      |       |      |
| Study condition=Control, n (%) | 1284 (49.6)  | 290 (46.7)    | 994 (50.5)   | .105  | .077 |
| Age, Mean (SD)           | 20.4 (1.7)   | 20.5 (1.8)    | 20.4 (1.7)   | .012  | .114 |
| Gender, n (%)            |              |               |              | .481  | .056 |
| Female                   | 1303 (50.3)  | 300 (48.3)    | 1003 (51.0)  |       |      |
| Male                     | 1253 (48.4)  | 314 (50.6)    | 939 (47.7)   |       |      |
| Non-binary or Other      | 26 (1.0)     | 6 (1.0)       | 20 (1.0)     |       |      |
| Race, n (%)              |              |               |              | .001  | .249 |
| White                    | 2159 (83.4)  | 547 (88.1)    | 1612 (82.0)  |       |      |
| Asian                    | 123 (4.8)    | 15 (2.4)      | 108 (5.5)    |       |      |
| Black                    | 38 (1.5)     | 2 (0.3)       | 36 (1.8)     |       |      |
| American Indian/Alaskan Native | 18 (0.7) | 5 (0.8) | 13 (0.7) | | |
| Multiracial              | 162 (6.3)    | 28 (4.5)      | 134 (6.8)    |       |      |
| Other                    | 50 (1.9)     | 15 (2.4)      | 35 (1.8)     |       |      |
| Refused                  | 38 (1.5)     | 9 (1.4)       | 29 (1.5)     |       |      |
| Ethnicity, Hispanic, n (%) | 275 (10.6) | 52 (8.4) | 223 (11.3) | .047 | .099 |
| Sexual Minority, n (%)   | 493 (19.0)   | 100 (16.1)    | 393 (20.0)   | .034  | .103 |
| Income, n (%)            |              |               |              | .604  | .063 |
| Live comfortably         | 673 (26.0)   | 162 (26.1)    | 511 (26.0)   |       |      |
| Meet needs with a little left | 1000 (38.6) | 232 (37.4) | 768 (39.0) |       |      |
| Just meet basic expenses | 778 (30.1)   | 198 (31.9)    | 580 (29.5)   |       |      |
| Don’t meet basic expenses | 137 (5.3)  | 29 (4.7)      | 108 (5.5)    |       |      |
| Current student, n (%)   | 1932 (74.7)  | 409 (65.9)    | 1523 (77.4)  | <.001 | .259 |
| Vaping frequency, nicotine, n (%) | 2410 (93.1) | 587 (94.5) | 1823 (92.7) |       |      |
| Daily or almost daily    |              |               |              | .271  | .077 |
| Less than daily, but at least weekly | 145 (5.6) | 27 (4.3) | 118 (6.0) |       |      |
| Less than weekly, but at least monthly | 33 (1.3) | 7 (1.1) | 26 (1.3) |       |      |
| Time to first vape, within 30 minutes | 2129 (82.3) | 523 (84.2) | 1606 (81.6) | .139 | .058 |
| Past year attempt to quit vaping, n (%) | 222 (8.6) | 64 (10.3) | 158 (8.0) | .035 | .134 |
| None                     |              |               |              |       |      |
| 1-2 times                | 674 (26.0)   | 180 (29.0)    | 494 (25.1)   |       |      |
| 3-5 times                | 911 (35.2)   | 198 (31.9)    | 713 (36.2)   |       |      |
| 6 or more times          | 781 (30.2)   | 179 (28.8)    | 602 (30.6)   |       |      |
| Motivation to quit vaping, mean (SD) | 4.54 (0.70) | 4.55 (0.72) | 4.53 (0.69) | .500  | .031 |
| Measure                                                                 | Group 1          | Group 2          | Group 3          | SMD     | P-value |
|------------------------------------------------------------------------|------------------|------------------|------------------|---------|---------|
| Confidence to quit vaping, mean (SD)                                    | 3.47 (1.15)      | 3.43 (1.17)      | 3.48 (1.15)      | .340    | .044    |
| No. closest friends that vape nicotine, M (SD)                         | 2.91 (1.49)      | 3.00 (1.51)      | 2.89 (1.49)      | .098    | .076    |
| Live with e-cig (nicotine) user, n (%)                                 | 1165 (45.0)      | 279 (44.9)       | 886 (45.0)       | 1.000   | .001    |
| Live with tobacco user, n (%)                                          | 916 (35.4)       | 223 (35.9)       | 693 (35.2)       | .775    | .015    |
| Past 30-day use cigarettes, n (%)                                      | 841 (32.5)       | 200 (32.2)       | 641 (32.6)       | .917    | .007    |
| Past 30-day use marijuana/cannabis, n (%)                              | 1534 (59.3)      | 365 (57.8)       | 1169 (59.4)      | .841    | .011    |
| Past 30-day binge drinking, n (%)                                      | 1929 (74.5)      | 464 (74.7)       | 1465 (74.5)      | .784    | .015    |
| PHQ-2, score 3 or greater, n (%)                                       | 910 (35.2)       | 207 (33.3)       | 703 (35.7)       | .307    | .049    |
| GAD-2, score 3 or greater, n (%)                                       | 1134 (43.8)      | 260 (41.9)       | 874 (44.4)       | .295    | .050    |

SMD: standardized mean difference
PHQ-2: Patient Health Questionnaire-2
GAD-2: Generalized Anxiety Disorder-2
### eTable 2. Sensitivity of Intervention Effects to Missing Data Assumptions

| OR.miss | FMI | P1   | P0   | Diff.vape | RR.vape | OR.vape | P-val |
|---------|-----|------|------|-----------|---------|---------|-------|
| 1/100   | 3   | 48.77| 40.48| 8.29      | 1.20    | 1.40    | <.0001|
| 1/20    | 9   | 46.69| 38.65| 8.04      | 1.21    | 1.39    | .0001 |
| 1/10    | 14  | 43.85| 36.31| 7.54      | 1.21    | 1.37    | .0002 |
| 1/5     | 19  | 40.48| 33.33| 7.14      | 1.21    | 1.36    | .0006 |
| 1/3     | 21  | 37.44| 30.56| 6.88      | 1.23    | 1.36    | .0011 |
| 1/2     | 21  | 35.23| 28.57| 6.66      | 1.23    | 1.36    | .0014 |
| 2/3     | 21  | 33.48| 27.01| 6.47      | 1.24    | 1.36    | .0016 |
| 4/5     | 20  | 32.25| 25.93| 6.32      | 1.24    | 1.36    | .0017 |
| 1       | 19  | 30.98| 24.81| 6.16      | 1.25    | 1.36    | .0018 |
| 5/4     | 18  | 30.32| 24.24| 6.08      | 1.25    | 1.36    | .0018 |
| 3/2     | 17  | 28.98| 23.08| 5.90      | 1.26    | 1.36    | .0018 |
| 2       | 15  | 28.28| 22.48| 5.80      | 1.26    | 1.36    | .0017 |
| 3       | 12  | 27.00| 21.26| 5.74      | 1.27    | 1.37    | .0015 |
| 5       | 9   | 25.51| 20.00| 5.51      | 1.28    | 1.37    | .0012 |
| 10      | 5   | 24.88| 19.36| 5.53      | 1.29    | 1.38    | .0010 |
| 20      | 3   | 24.88| 19.36| 5.53      | 1.29    | 1.38    | .0009 |
| 100     | 1   | 24.09| 18.70| 5.39      | 1.29    | 1.38    | .0008 |
| ITT     | 0   | 24.08| 18.63| 5.45      | 1.29    | 1.39    | .0007 |
| CCA     | 24  | 32.27| 24.04| 8.23      | 1.34    | 1.51    | .0001 |

OR.miss = assumed Odds Ratio capturing the association of vaping and survey non-response
FMI = Fraction of Missing Information in multiple imputation estimate of log(OR.vape)
P1 = abstinence rate (%) in intervention arm
P0 = abstinence rate (%) in assessment-only control arm
Diff.vape = P1-P0 = difference in abstinence rates between intervention and control arms
RR.vape = P1/P0 = abstinence Rate Ratio between intervention and control arms
OR.vape = [P1/(1-P1)]/[P0/(1-P0)] = Odds Ratio capturing the association of abstinence and intervention arm
ITT = Intention-to-Treat (OR.miss=+∞)
CCA= Complete Case Analysis
**eTable 3. Moderators of Intervention Effects on 30-day ITT Abstinence Rates.**

|                              | Beta* | Std. Error | P-value* |
|------------------------------|-------|------------|----------|
| Age                          | -.022 | .057       | .705     |
| Gender (reference = Male)    |       |            | .321     |
| Female                       | .273  | .195       | .162     |
| Non-binary or Other          | -.366 | .896       | .682     |
| Race (reference = White)     |       |            | .116     |
| Asian                        | -.241 | .421       | .567     |
| Black                        | -.592 | .674       | .379     |
| American Indian/Alaskan Native | -2.387 | 1.302     | .068     |
| Multiracial                  | .392  | .383       | .306     |
| Other                        | -.142 | .767       | .064     |
| Refused                      | -.554 | .946       | .558     |
| Ethnicity, Hispanic           | -.386 | .291       | .186     |
| Sexual Minority              | .285  | .250       | .255     |
| Income (reference = Live comfortably) | .023  | .244       | .926     |
| Meet needs with a little left |       |            | .951     |
| Just meet basic expenses     | .025  | .258       | .922     |
| Don’t meet basic expenses    | -.239 | .467       | .609     |
| Current student              | .305  | .226       | .178     |
| Vaping frequency (reference = Daily/almost Daily) |       |            | .377     |
| Less than daily, but at least weekly | -.143 | .370       | .699     |
| Less than weekly, but at least monthly | -1.431 | 1.170 | .221     |
| Time to first vape, within 30 minutes | .267  | .232       | .250     |
| Past year attempt to quit vaping (reference = none) |  |  |  |
| 1-2 times                    | .285  | .398       | .474     |
| 3-5 times                    | -.201 | .380       | .597     |
| Motivation to quit vaping    | .071  | .152       | .643     |
| Confidence to quit vaping    | -.138 | .087       | .113     |
| No. closest friends that vape nicotine | .030  | .064       | .642     |
| Live with e-cig (nicotine) user | -.183 | .196       | .348     |
| Live with tobacco user       | -.102 | .201       | .613     |
| Past 30-day use cigarettes   | -.021 | .207       | .919     |
| Past 30-day use marijuana/cannabis | .088  | .195       | .653     |
| Past 30-day binge drinking   | .128  | .229       | .575     |
| PHQ-2, score 3 or greater    | -.002 | .202       | .993     |
| GAD-2, score 3 or greater    | .078  | .195       | .690     |

*TIQ vs. Control differences in abstinence rates measured in the log-odds ratio scale. Positive signs indicate that TIQ performed better than assessment-only control.
For multi-category factors, omnibus p-values test for TIQ moderation effects across all factor categories. They are supplemented by p-values in italics for category-specific comparisons vs. the reference group.
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