Quantifying CHI doorstep concerns as risk factors of Wave 1 nonresponse for the CE Interview Survey

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Contents

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Summary

Objective. The objective of this study is to quantify the association of sample units' expressions of initial reluctance at the survey request, as represented by "doorstep concerns" recorded in the Contact History Instrument (CHI), with Wave 1 survey (or unit) nonresponse in the CE Interview Survey (CE).

Application. If these doorstep concerns on Wave 1 unit nonresponse vary in a quantifiable way, we can potentially differentiate among sample units who are at varying degrees of risk of nonresponse: sample units with concerns that are associated with higher nonresponse propensity labelled as "high risk of nonresponse", and sample units with concerns that are associated with lowest nonresponse propensity as "low risk of nonresponse," and others in between as "potential risk of nonresponse." Following survey management and adaptive design principles of focusing resources on cases for which data collection interventions can most effectively solicit response, this research can help identify cases that are more likely to benefit from such interventions and deploy resources more efficiently. Accordingly, we would propose targeting interventions on sample units identified as "potential risk of nonresponse" as a priority over sample units in a "low risk" or "high risk" categories. In addition, knowledge of which of these doorstep concern risk factors affect subsets of sample units can inform how the interventions can be tailored for them.

Methodology. We used multivariate logistic regression with Wave 1 survey nonresponse modelled as the event of interest, and doorstep concerns (DS) "themes" from the CHI as the primary risk factors of interest. In addition to the usual diagnostics and goodness-of-fit assessments of the final model, we used data from outside the study sample (i.e. data from a different time period) to re-estimate the final model, and computed "approximate" population adjusted risk statistics to take account of the difference in proportions of doorstep concerns among members of the study sample. However, we did not take account of the complex survey design of the CE in our analysis.[1]

Findings.

1. The odds of Wave 1 nonresponse among sample units observed with the "Not interested/Hostility" DS theme was at least two times *higher* compared to sample units without this DS theme (Table 6). We propose these sample units be classified as "high risk" of unit nonresponse.

[1] Our study sample was created as a subset of the production sample because we subset the production sample to sample units to have at least 1 contact record in the Contact History Instrument for their doorstep concerns to be recorded. Thus, the final weights and replicate weights in the production data files would not be applicable.

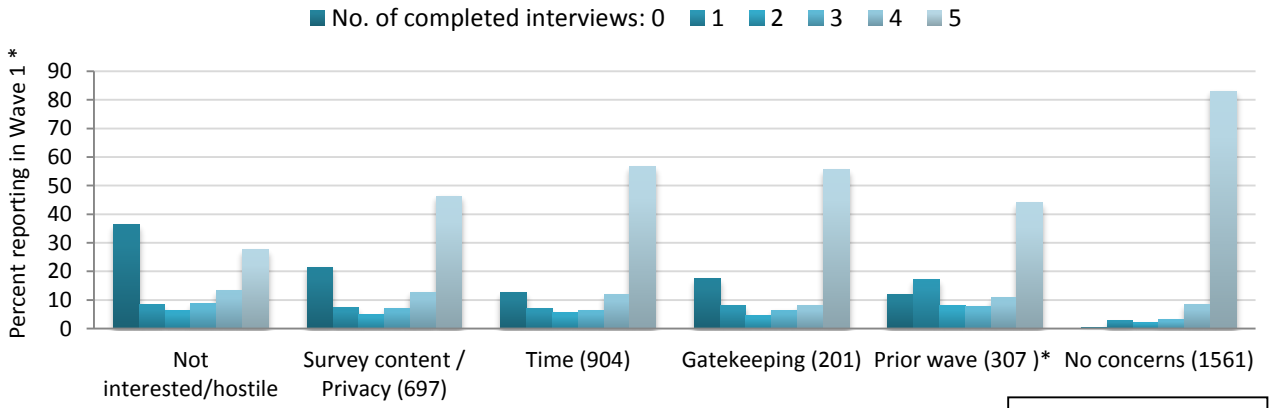
2. The odds of Wave 1 nonresponse among sample units with “Time”, or “Gatekeeping,” or “Survey content/Privacy” DS themes, respectively, were not consistently higher or lower compared to sample units without each of these DS themes. We propose sample units with any of these DS themes be classified as “potential risk” of nonresponse.
3. The odds of Wave 1 nonresponse among sample units without any doorstep concerns is about 4 times lower compared to sample units with concerns. We propose they be classified as “low risk” of nonresponse.

I. Introduction

One of the main areas of research using Contact History Instrument (CHI) data on interviewer perceptions of contacted sample person's reactions at the time of the survey request (doorstep concerns) has been to predict survey cooperation (unit response). Unlike socio-demographic information that largely depend on sample units' response to the survey, CHI information have the advantage of being available for a larger proportion of the eligible sample since these data are (theoretically) available for all sample units who have been contactd at least once regardless of the final outcome of the survey request. CHI data have been found to improve the ability to predict unit response over socio-demographic variables alone (e.g. Groves and Couper (1996), Bates, Dahlhamer, and Singer (2008), Dahlhamer and Simile (2009)). In addition to predicting final disposition, because doorstep concerns and other CHI information about the sample unit are available even before a case is resolved, these data can be used to identify and prioritize potential non-responding households who could benefit from further recruitment efforts over others who may not.

Among the findings in their exploratory study on the associations between contacted sample units' doorstep concerns from the CHI and key survey performance measures for the Consumer Expenditure Interview Survey (CEQ), Kopp, McBride, and Tan (2013) found that the propensity to complete none or all 5 waves of the CEQ survey panel differed significantly among doorstep concern "themes." This suggests that different themes affect survey response differently.

Association of doorstep concern themes in Wave 1 with prevalence of completed interviews in the CE Interview Survey panel (Kopp, McBride, and Tan 2013, Figure 4b)



We extend the univariate (single predictor) analyses of Kopp et al. (2013) by using multivariate methods to further develop our understanding of how doorstep concerns and other CHI information, particularly from Wave 1, associate with response propensity in the CEQ survey panel. The first question we attempt towards this endeavor and we which is the topic of this study is to quantify the association of doorstep concerns with Wave 1 survey nonresponse, and examine how these effects may differ by type of doorstep concerns.

We focus on Wave 1 because that is the first encounter that sample units have with the CEQ, and thus an understanding of the effects of Wave 1 doorstep concerns on survey cooperation can serve as a baseline for the effects of the doorstep concerns in subsequent waves of the survey panel. In addition, we have anecdotal evidence that sample units who are Wave 1 respondents are more likely to also be respondents in Wave 2, compared to Wave 1 nonrespondents. For example, 69 percent of Wave 1 respondents were also Wave 2 respondents compared to only 6 percent of Wave 1 nonrespondents in the study sample of Tseng & Tan (2011; N=7,773) ; in the study sample of in Kopp et al (2013; N=3,000), it was 79 percent of Wave 1 respondents to 4 percent Wave 1 nonrespondents. This suggests that minimizing Wave 1 nonresponse may have positive association with minimizing survey nonresponse in Wave 2.

Application. If the effects of these doorstep concerns on Wave 1 survey nonresponse vary in a quantifiable way, then we can potentially differentiate among sample units who are at risk of survey nonresponse: labelling sample units with concerns that are associated with higher nonresponse propensity as “high risk of nonresponse”, and sample units with concerns that are associated with lower nonresponse propensity as “potential risk of nonresponse,” or “low risk of nonresponse.” Following survey management and responsive design principles of focusing resources on cases for which data collection interventions can most effectively solicit response, this research can help identify cases more likely to benefit from such interventions. Accordingly, we would advise targeting interventions on sample units with “potential risk of nonresponse,” over sample units identified to be “low risk” or “high risk.” In addition, knowledge of how these doorstep concern risk factors affect subsets of sample units can help in the tailoring of survey solicitation strategies to mitigate those risks.

II. Methods

a. Study sample & outside-sample data

Our study sample is the same as that used in the study by Kopp et al. (2013) - these were sample units whose Wave 1 eligibility occurred on or after October 2011 and their Wave 5 eligibility occurred by the end of March 2013, and whose final outcome to each survey request was known for all 5 waves of their survey panel during this period. Excluded from the study sample were replacement sample units and sample units who were never contacted. These criteria yielded a study sample of 3,000 unique sample units who belonged to 6 CEQ survey

panels.[2] For this study, we use only the Wave 1 data of the study sample. Among the 3,000 sample units in the study sample, 13.6 percent were nonrespondents in Wave 1.

We also extracted additional Wave 1 data of eligible sample units from a different time period, April 2013 through November 2013, to form our "outside-study sample." Excluded sample units were those whose CHI records indicated they were never contacted. This outside-study sample was used to re-estimate the final multivariate logistic model.

All data analyses in this study was conducted using SAS version 9.3.

b. Formation of doorstep concern themes.

We followed the strategy of Kopp et al. (2013, Table 7) in grouping the CHI doorstep concern (DS) items to form "themes", as shown in Table 1 below. They adopted this pre-defined, "fixed items" approach of assigning items to DS themes so that the themes could be easily understood and be based on a consistent set of items at every wave of the CEQ survey panel. Table 1 also shows the indicator variable name of each DS theme used in our analysis. Since this study focuses on Wave 1, the theme "Prior Wave" is excluded from our analyses; however, there were sample units for which these DS items were reported in the study sample. For this study, we created another DS theme "Other" and its indicator variable, "ioth" to indicate if any of the "Prior Wave" items or the DS item "23-Other: specify" were observed for the sample unit.

If a sample unit's contact attempt history in Wave 1 showed that a DS item in Table 1 was recorded at least once, the corresponding DS theme indicator variable was flagged to indicate that DS theme was observed at least once in Wave 1 for the sample unit. For example, if a sample unit's contact attempt history indicated at least one Wave 1 occurrence of the DS item "2-too busy", then the indicator variable "itime1" was assigned the value 1 for that sample unit. There was also an indicator variable, "inoconc1" set to value 1 to identify a sample unit without any DS concerns noted in its contact attempt history.

[2] For a more detailed description of the study sample, see Appendix A Table A1.

Table 1. Grouping of CHI doorstep concern items to form doorstep concern themes

Doorstep concern theme	Prior Wave *[not relevant for Wave 1]*	Time	Not interested/ Hostilty	Survey Content/ Privacy	Gatekeeping
Indicator variable (suffix j is Wave #j)	ipwavej	itimej	inhj	icpj	igatej
CHI doorstep concern items	16 - R. requests same FR 17-info previously given 18 - too many questions previously 19- too many interviews 20 - intv too long previously 21-intends to quit survey	2-too busy 3-intv too time consuming 4-brk appt-puts off FR indefinitely 5-scheduling difficulty	1-not interested 11-hangs up/slams door 12-hostile /threatening	6-survey voluntary 7-privacy concerns 8-anti-govt 9-does not understand survey 10-survey content not applicable	13-othr hh members say don't do survey 14-talk to specific hh member 15-family issues
No. items:	6	4	3	5	3

Note: Since this study focuses on Wave 1, the theme "Prior Wave" is excluded from our analyses; however, there were sample units for which these DS items were reported in the study sample. For this study, we created another DS theme indicator, "ioth" to indicate if any of the "Prior Wave" items, or the DS item "23-Other: specify" were observed for the sample unit.

c. Risk factors

In this study, the event of interest to be modelled is unit nonresponse in Wave 1, with the risk factors of interest being the DS themes in Wave 1. The frequency distribution of the number of DS themes reported, the combinations of themes reported, and the rate of Wave 1 survey nonresponse by these theme combinations for the study sample are shown in Table 2. More than half of the sample units were observed to have no doorstep concerns (52.0 percent). The most frequently reported number of DS themes for sample units was one (22.7 percent). Among sample units with only one DS theme, "Time" (n=412) was the most frequent theme observed and "Not interested/Hostility" (n=54) was the least frequent; however, the prevalence of unit nonresponse was 10.7 percent compared to 50.0 percent, respectively, for these 2 DS themes, suggesting "Time" and "Not interested/Hostility" have differential effects on response propensity . In addition, regardless of the number of themes observed, the rates of Wave 1 nonresponse were *consistently highest* among sample units whose DS theme combinations included "Not interested/Hostility."

Table 2. Combination of DS themes observed and final disposition of nonresponse in Wave 1

No. of DS themes reported	Combination of DS themes*	No. of sample units with combination (n)	Percent distribution (n/N=3,000)	% nonresponse for theme combination **
0	00000	1,561	52.0	2.1
1		812	27.1	
	10000	54	1.8	50.0
	00010	38	1.3	21.1
	01000	178	5.9	11.2
	00100	412	13.7	10.7
	00001	130	4.3	9.2
2		401	13.4	
	11000	96	3.2	72.9
	10100	52	1.7	46.2
	10010	5	0.2	20.0
	00110	41	1.4	19.5
	01100	153	5.1	14.4
	01110	33	1.1	9.1
	01010	21	0.7	4.8
3		186	6.2	
	11010	13	0.4	61.5
	10110	10	0.3	60.0
	11100	163	5.4	58.9
4	11110	40	1.3	62.5
Total		3000	100.0	407

* Note on theme combination pattern: the 1st position represents the theme of inh, the 2nd icp, the 3rd itime, the 4th igate, and the 5th ioth; the value '0' implies the theme was not observed, '1' that the theme was observed.
** For e.g., of the 54 sample units reported have the DS theme combination '10000', 50 percent resolved as nonresponse.

In addition to the DS themes described in Table 1, other CHI information were included in our multivariate analyses to serve as control variables. We considered the following factors to be indicative of a "difficult" case and positively associated with the likelihood of survey nonresponse:

1. If a sample unit's contact attempt history indicated there was at least 1 change in interviewer *(ichgfrwv1=1)*
2. A lower proportion (compared to sample median) of contact attempts resulting in contact with the sample unit *(ipctatmp1=0)*
3. A higher (compared to sample median) number of days between the first and final contact attempt. The longer a case stays unresolved may be an indication of a case at risk *(indaysatm1l1=1)*
4. A higher (compared to sample median) proportion of soft (interim) refusals *(ipctsftr=1)*
5. One or more contact attempt strategies were used *(istrg1=1)*

Among socio-demographic variables for controls, we considered factors for which information may be obtained without an interview:

6. If the sample unit lived in a dwelling structure with only a single housing unit *(isglhunit1=1)*
7. If the housing unit was within a MSA *(imsa1=1)*
8. If 20% or more of the population in the tract lived in poverty *(iareapov1=1)*
9. If the size of consumer unit was larger than the sample median *(igpsize=1)*

Race (whether White or not), language spoken upon contact (whether English or not, from CHI) were also considered, but dropped from consideration for the multivariate analyses because of their high incidence of missing values among nonrespondents (394 and 379 sample units missing race and language, respectively, out of 407 Wave 1 nonrespondents, see Table 3).

The descriptive statistics for continuous variables are displayed in Appendix A Table A2. Median values of these continuous variables from the "overall" group were used to create corresponding indicator variables shown in Table 3. The counts and distribution of the categorical risk and control factors considered for the multivariate analyses of DS themes and survey nonresponse in Wave 1 are shown in columns 4 through 7 in Table3.

d. Bivariate analysis

Logistic regressions with Wave 1 nonresponse as the event modelled (dependent variable) were conducted with each of the risk factors as a single predictor. This provided the unadjusted odds ratios and Chi-square statistic. These results appear in columns 8 through 11 of Table 3.

Table 3. Distribution statistics on potential predictors and unadjusted odds ratios from bivariate logistic regression modelling survey nonresponse in Wave 1 as the event

Variable	Description		Wave 1 final disposition				Unadjusted OR	95LCI	95UCI	WaldChi p
			Nonreponse (N=407)		Response (N=2,593)					
			N	%	N	%				
inoconc1	No DS concerns	0=No	375	12.5	1064	35.5	0.06	0.04	0.09	<.0001
		1=Yes	32	1.1	1529	51.0				
inh1	DS: not interested / hostility	0	150	5.0	2417	80.6	23.53	18.27	30.30	<.0001
		1	257	8.6	176	5.9				
icp1	DS: survey content / privacy	0	162	5.4	2141	71.4	7.16	5.73	8.95	<.0001
		1	245	8.2	452	15.1				

Table 3. Distribution statistics on potential predictors and unadjusted odds ratios from bivariate logistic regression modelling survey nonresponse in Wave 1 as the event

Variable	Description		Wave 1 final disposition				Unadjusted OR	95LCI	95UCI	WaldChi p
			Nonreponse (N=407)		Response (N=2,593)					
			N	%	N	%				
itime1	DS: time	0	179	6.0	1917	63.9	3.61	2.92	4.48	<.0001
		1	228	7.6	676	22.5				
igate1	DS: gatekeeping	0	347	11.6	2452	81.7	3.01	2.18	4.15	<.0001
		1	60	2.0	141	4.7				
ichgfrwv1	At least 1 interviewer change	0=No	342	11.4	1535	51.2	11.23	8.90	14.16	<.0001
		1=Yes	65	2.2	1058	35.3				
ipctatmp1	More than ½ attempts resulted in contact	0	342	11.4	1535	51.2	0.28	0.21	0.36	<.0001
		1	65	2.2	1058	35.3				
indaysatm1l1	No. days between 1st and last attempt >10	0	55	1.8	1492	49.7	8.67	6.46	11.64	<.0001
		1	352	11.7	1101	36.7				
ipctsftr1	Any soft refusal	0	160	5.3	2413	80.4	20.70	16.12	26.57	<.0001
		1	247	8.2	180	6				
istrg1	At least 1 strategy used	0	217	7.2	1458	48.6	1.13	0.91	1.39	0.2717
		1	190	6.3	1135	37.8				
isglhunit1	Single housing unit in structure	missing	15	0.5	10	0.3	1.32	1.02	1.70	0.0325
		0	88	2.9	713	23.8				
		1	304	10.1	1870	62.3				
imsa1	In MSA	0	41	1.4	311	10.4	1.22	0.86	1.72	0.2639
		1	366	12.2	2282	76.1				
iareapov1	>=20% in poverty	0	352	11.7	2214	73.8	0.91	0.67	1.24	0.5567
		1	55	1.8	379	12.6				
igpsize1	CU size > 2	0	276	9.2	1525	50.8	0.68	0.54	0.85	0.0006
		1	131	4.4	1068	35.6				
ilang1	English	missing	394	13.1	10	0.3	0.31	0.07	1.42	0.1329
		0	2	0.1	139	4.6				
		1	11	0.4	2444	81.5				
ircwhite1	White	missing	379	12.6	.	.	0.45	0.21	0.98	0.0429
		0	11	0.4	589	19.6				
		1	17	0.6	2004	66.8				
ihmowner1	Homeowner	0	103	3.4	742	24.7	1.18	0.93	1.50	0.1681
		1	304	10.1	1851	61.7				

Note: For each categorical variable, the "%" columns (columns 5 and 7) show the cell percent distribution for each combination of level and final disposition, and sum to 100%.

e. Multivariate logistic regression

We first considered a model without any CHI information (non-CHI model). A factor from Table 3 was added to this non-CHI model if its p-value from the bivariate Chi-square test was less than 0.25 (Hosmer & Lemeshow 1989, p. 86), or it was of substantive interest. Subsequently, nested models were compared and factors were retained if they were significant at $p<0.05$. Interactions were considered significant at $p<0.01$. Since the association of each DS theme with survey nonresponse was the primary issue of interest, all DS theme indicators were retained in the final model, regardless of their statistical significance.

The addition of the DS themes and other CHI factors to the no-CHI model improved the area under the Receiver Operating Curve from 0.57 to 0.92 (see Appendix B, Table B1, Model NoCHI and Model 3). The Likelihood ratio test of this pair of nested models confirmed the improvement in the overall fit of the model when the CHI information was included (Likelihood Ratio statistic Chi-square with 10 degrees of freedom had p-value<0.01; AIC of 1,348 compared to 2,309).

Given the high rate of nonresponse for the combinations of themes that included "Not interested/Hostility" reflected in Table 2, we also examined the interaction between "Not interested/Hostility" and other themes (see Appendix B, Table B2). Only the pair "Not interested/Hostility" and "Survey content/Privacy", inh1* icp1, was significant ($p<0.001$). The estimated parameters of the final model with and without this interaction term appear in Appendix B, Table B3. However, we chose the final model to exclude this interaction term based on re-estimating the model with this interaction using 3 separate monthly data from the outside-study sample; this interaction effect was not consistently significant($p>0.3$) (see Appendix B, Table B4).[3] In addition, we observed greater fluctuation in the magnitudes of estimated logistic coefficients using monthly data for the model including the interaction effect (e.g. the coefficients of icp1, ipcatmp1, and istrg1 in Table B4) compared to the model without the interaction term. For these reasons, and the principle of parsimony, we selected the final model to exclude the interaction term.

f. Assessment of the final model.

Multicollinearity.

We looked for indications of multicollinearity (when two or more predictors are near perfect linear combinations of one another) among the predictors. The variance inflation factor of all predictors in the final model was less

[3] We used monthly data for estimation because that is the regular duration of the CE Interview Survey's field period for data collection, and thus would provide some idea of the impact of having monthly data for estimating such models in "real time".

than 1.5, and the largest condition index value was 8.8, suggesting that multicollinearity was not a significant problem (see Appendix C, Table C1).

Model selection.

We compared pairs of nested models using the Log Likelihood ratio test, as well as giving consideration to their relative AIC values. We examined the estimated overdispersion parameter for each model, as well as the overall measures of goodness-of-fit, significance of the Hosmer-Lemeshow statistic, and the area of the Receiver Operating Curve (ROC). Although not significant ($p>0.4$), the variable ISTRG1 variable was left in the model to correct for overdispersion (estimated overdispersion parameter = 1.22, $p<0.01$, when ISTRG1 was excluded); its inclusion reduced the estimated overdispersion parameter to close to 1. The other models we considered are documented in Appendix B.

Outliers.

The diagnostic statistics, graphs, and influential covariate patterns for the final model are shown in Appendix C. We identified covariate patterns that were poorly fitted by large changes in their Pearson Chi-square statistic or Deviance statistic (DELTAChi or DELTAd values greater than 4), shown in Appendix C, Table C2. From this subset of covariate patterns, we identified those with a large influence on estimated coefficients identified by causing large changes in all the model coefficients when all subjects with a specific covariate pattern were removed from the model estimation (large DELTAbeta values; Hosmer & Lemeshow, equations 5.10-5.11, page 156). In a separate analyses, we re-estimated the final model after excluding two of these poorly fitted and influential covariate patterns one at a time (see Appendix C Table C3), and another final model estimation excluding 7 of these covariate patterns simultaneously (see Table C4). We concluded that the estimated final model parameters for the risk factors of interest did not change substantively with the exclusion of the covariate patterns, so the final model estimation was done without excluding any covariate pattern.

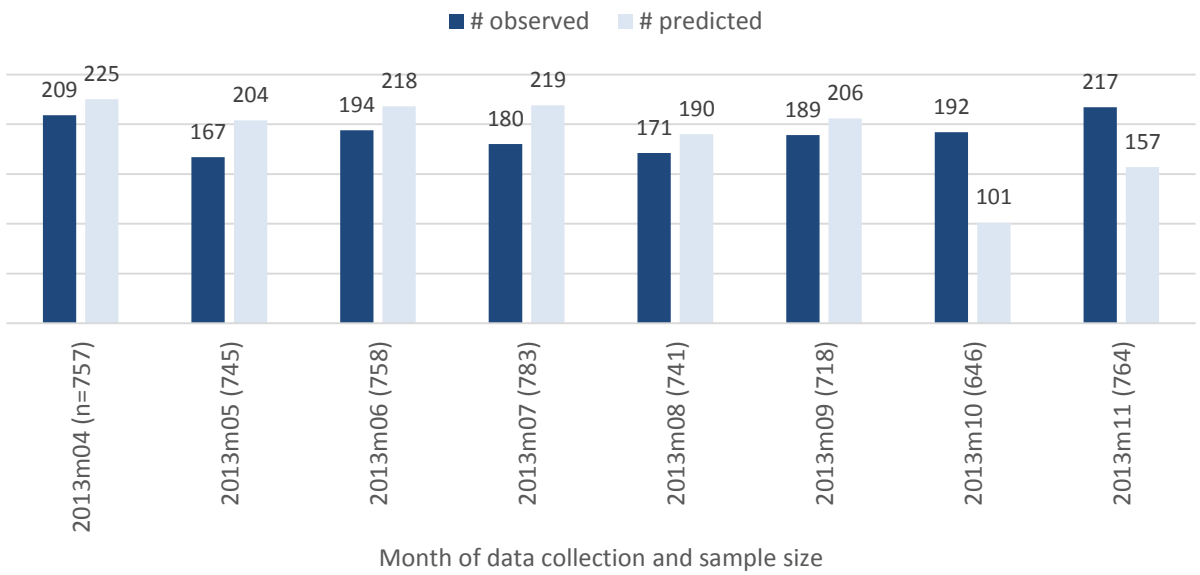
Classification accuracy.

Even if the predictors in the final model had no relationship to the dependent variable, the model can still correctly classify group membership by chance – referred to as "by chance accuracy". Using the marginal frequencies for the number of events and nonevents in the study sample, the proportional-by chance accuracy rate was computed as [(407/3000)^2 + (2593/3000)^2]=0.765 (for example, see page 203 in Petrucci 2009). For the generally acceptable prediction improvement criteria of 25 percent over the proportional-by chance accuracy rate, the accuracy criteria would be (1.25*76.5%)= 95.7 percent for our application. However, our final model's accuracy rate is 90.7 percent (from the final model's classification table at the predicted probability cutoff of 0.5), which is only about an 18 percent prediction improvement.

g. Use of outside-sample data

We re-estimated the final model using data collected from a time period different from that for the study sample: using April 2013, July 2013, and September 2013 separately, as well as using 8 months, April 2013 through November 2013, collectively (see Appendix C Table C5). We chose to examine estimated parameters using only one month of Wave 1 sample units because in practice, a new sample of Wave 1 sample units is in the field each month for the CE Interview Survey. We wanted to see how the final model's estimated coefficients for the DS themes fluctuated with typical one-month sample sizes. We also compared the observed number of events (i.e. Wave 1 unit nonresponse) each month with the final model's predicted number of events each month. We summed up the predicted probabilities from the final model estimated using the 8 months of outside-sample collectively to get the count of predicted events, and compared that to the number of observed events in each month as shown in Figure 1 (see Appendix C, Table C8 for estimated parameters).

Figure 1. Observed and predicted counts of Wave 1 survey nonresponse from final model covariates using outside-study sample



h. "Approximate" population attributable risk

Since the prevalence of the different risk factors among the study sample was highly variable, the overall effect of a significant risk factor with a large estimated coefficient might be small if occurs very infrequently among the population. In public health research, the population attributable risk statistic (PAR) describes the proportion of a disease that could be prevented if exposure to a specific risk factor could be eliminated from the target population.

For our application, the PAR measure would quantify the proportional reduction of Wave 1 unit nonresponse that would occur if exposure to a specific risk factor could be eliminated. The PAR was computed as:

$$r_j*(OR_j-1) / [1+ r_j*(OR_j-1)],$$

where j is the index for the risk factor, and r_j the proportion of the sample exposed to factor j (e.g. Taylor 1977). Although PAR computations have typically been applied to case-control (prospective) studies, the prevalence of exposures are estimated from the target population, and relative risk instead of odds ratios are used in the PAR formula, we use this statistic "approximately" to provide a perspective on the relative importance of the risk factors associated with Wave 1 unit nonresponse by taking account of their prevalence; we refer to it as the "approximate PAR" statistic for our study. In our study sample, eliminating the positive factor of "no concerns" would 'approximately' increase the proportion of Wave 1 nonresponse by 64%, and eliminating the negative factor of "not interested/hostility" would reduce the proportion of Wave 1 nonresponse by 38 percent (see Table 4).

III. Findings

The estimated parameters from the final multivariate logistic regression model for Wave 1 unit nonresponse is summarized in Table 4.

Table 4. Estimated parameters from final logistic regression model.
Dependent variable (event): Wave 1 unit nonresponse.

Risk factors (j)	Proportion sample with exposure (r_j)	Logistic coefficient	SE	P value	Odds Ratio (OR_j)	95LCI	95UCI	Approximate population attributable risk
intercept		-3.16	0.27	<.001				
inoconc1	0.520	-1.40	0.25	<.001	0.25	0.15	0.40	-0.64
DS themes								
inh1	0.144	1.65	0.18	<.001	5.18	3.67	7.35	0.38
icp1	0.232	0.11	0.17	0.522	1.11	0.80	1.55	0.02
itime1	0.301	-0.23	0.16	0.162	0.8	0.58	1.10	-0.06
igate1	0.067	0.13	0.22	0.558	1.14	0.74	1.75	0.01
ichgfrwv1	0.374	0.83	0.16	<.001	2.29	1.69	3.11	0.33
ipctatmp1	0.374	-1.26	0.19	<.0001	0.28	0.20	0.41	-0.37
indaysatm1l1	0.484	1.04	0.19	<.001	2.82	1.97	4.08	0.47
ipctsftr1	0.142	1.16	0.18	<.001	3.18	2.25	4.50	0.24
istrg1	0.442	-0.10	0.15	0.504	0.91	0.68	1.21	-0.04
isglhunit1	0.725	0.43	0.17	0.012	1.54	1.11	2.16	0.28

N=2,583; No. of events=392; No. of unique covariate patterns: 424
Overdispersion parameter: 1.08 (p>0.1)
-2 Log Likelihood: 1,325; AIC: 1,348
Hosmer & Lemeshow Chisq: 12.12, df=8, p=0.15
Classification: %Concordant=92.1, % Discordant=7.6, ROC area=0.92
Prediction improvement over "by-chance accuracy": 18%

Our research interest was in how the DS themes associated with Wave 1 nonresponse. The sample distribution statistics in Table 2 had suggested differential effects among the DS themes on Wave 1 nonresponse, and the multivariate analysis confirmed this. In the study sample, sample units identified with the DS theme "Not interested/Hostility" had odds of unit nonresponse in Wave 1 that were 5 (3.7, 7.4) times higher than sample units not identified with this theme, holding other factors constant.[4] Other DS themes were not statistically significant. In contrast, the odds of Wave 1 unit nonresponse among sample units without any DS concerns was 4 (0.2, 0.4) times lower compared to sample units with concerns.

Other non-DS concerns risk factors from the sample units' contact history that were significantly associated with higher odds of Wave 1 nonresponse were: the need for more than one interviewer to resolve the case (1.7, 3.1), a longer duration between the first and final contact attempt (2.0, 4.1), and a higher rate of interim "soft refusal" (2.3, 4.5). However, the odds associated with "Not interested/hostility" remained higher than each of these 3 risk factors related to characteristics of contact attempt.

When the differential proportions of the sample exposed to each DS theme risk factor was taken into account, the effect of the DS theme "Not interested/hostility" measured by the "approximate PAR" statistic, 0.38, moved closer to the three significant non-DS concerns risk factors, but it remained larger than the PAR values of the other DS themes "Survey content/Privacy" "Time", and "Gatekeeping" (0.02, -0.06, and 0.01, respectively).

An alternative presentation of the final model's estimated parameters is in the form of the predicted probability of Wave 1 unit nonresponse. The observed probability and the predicted probability by the presence of DS themes is presented in Table 5.

Table 5. Predicted probabilities of Wave 1 nonresponse from final model

				Wave 1 unit nonresponse			
Presence of doorstep concern themes	# profiles	# sample units	# events	Observed probability	Predicted probability	95LCI	95UCI
No doorstep themes observed	39	1,561	32	0.02	0.04	0.02	0.06
Yes - excluding"Not interested / Hostility"	218	1,006	118	0.12	0.15	0.13	0.17
Yes – including "Not interested / Hostility"	184	433	257	0.59	0.49	0.46	0.53

Note:
Observed probability = # events / # sample units, where event is Wave 1 nonresponse.
Predicted probability = $\exp\left(constant + \sum_j \hat{b}_j x_{j_j}\right) / [1 + \exp\left(constant + \sum_j \hat{b}_j x_{j_j}\right)]$

[4] Notation: the 95% confidence interval for the reported odds ratio is shown by the interval in parenthesis, e.g. (3.7, 7.4).

Estimated effects of doorstep concern themes

We used outside-sample data to re-estimate the final model as an informal indication of the generalizability of the magnitudes of the DS theme risk factors. The odds ratios for the doorstep concerns on Wave 1 unit nonresponse estimated from the final multivariate logistic regression model using the outside-study sample are summarized in Table 6. This summary table highlights the following:

1. *Not interested / hostility:* the point estimate of the odds ratio continued to be greater than 1 and significant, but its effect weakened to about 3 (2.9, 4.6) times higher odds of Wave 1 unit nonresponse with final model estimation using combined 8 months of outside-sample data.
2. *No doorstep concerns*: the point estimate of the odds ratio continued to be less than 1, but this effect weakened (0.63, 1.04) with final model estimation using the combined 8 months of outside-sample data.
3. *Time*: the point estimate of the odds ratio fluctuated between greater and less than 1 for monthly outside-sample estimation. However, it is close to the final model point estimate and it does reach significance when the combined 8 months of outside-sample data were used (0.61, 0.95).
4. *Gatekeeping* and *Survey content/Privacy*: the point estimate of the odds ratio fluctuated between greater and less than 1, and persists in being not significant.

From estimating the final model using the study sample and outside-sample data, we conclude the following:

- The odds of Wave 1 nonresponse among sample units with the "Not interested/hostility" DS theme was at least two times higher compared to sample units without this DS theme. We would thus classify these sample units as "high risk" of unit nonresponse in Wave 1;
- The odds of Wave 1 unit nonresponse among sample units with "Time", "Gatekeeping," "Survey content/Privacy" DS themes was not consistently significantly different from sample units without these DS themes. We would classify these sample units as "potential risk of unit nonresponse in Wave 1;
- The odds of Wave 1 nonresponse among sample units without any doorstep concerns was about 4 times *lower* compared to sample units with concerns. We propose they be classified as "low risk" of nonresponse.

Table 6. Summary of estimated odds ratios of doorstep concerns from final multivariate logistic model using outside-study sample

	OR	95LCI	95UCI		OR	95LCI	95UCI
No DS concerns (inoconc1)				*Time (itime1)*			
Final model	0.25	0.15	0.40	Final model	0.80	0.58	1.10
Outside sample estimation				Outside sample estimation			
2013 m4	0.26	0.12	0.53	2013 m4	0.71	0.43	1.19
2013 m7	0.22	0.10	0.48	2013 m7	0.74	0.44	1.27
2013 m9	0.45	0.20	0.99	2013 m9	1.48	0.85	2.59
2013 m4 through m11	0.81	0.63	1.04	2013 m4 through m11	0.76	0.61	0.95
Not interested/hostility (inh1)				*Gatekeeping (igate1)*			
Final model	5.18	3.67	7.35	Final model	1.14	0.74	1.75
Outside sample estimation				Outside sample estimation			
2013 m4	4.76	2.80	8.20	2013 m4	1.16	0.60	2.25
2013 m7	3.53	2.03	6.14	2013 m7	0.65	0.30	1.37
2013 m9	4.14	2.25	7.67	2013 m9	0.68	0.30	1.49
2013 m4 through m11	3.62	2.87	4.56	2013 m4 through m11	1.04	0.76	1.40
Survey content/Privacy (Icp1)							
Final model	1.11	0.80	1.55				
Outside sample estimation							
2013 m4	0.90	0.53	1.50				
2013 m7	0.96	0.56	1.64				
2013 m9	1.04	0.58	1.83				
2013 m4 through m11	0.82	0.66	1.03				

IV. Limitations

The primary limitations regarding the use of CHI doorstep concerns were described in Kopp et al. (2013), and reiterated here:

1. Inadequate testing of the DS items used to form the DS themes implies we have no verification that these themes represent what we intend;

2. The current CHI instrument does not indicate whether the contacted sampled person on whom doorstep concerns data were observed is also the respondent;

3. The CHI relies on interviewer reports of DS concerns without checks to ensure consistency in how these items are reported;

In addition, we did not adjust standard errors to account for the complex survey design of the CE Interview Survey. Our study sample was created as a subset of the production sample because we subset the production sample to

sample units to have at least 1 contact record in the Contact History Instrument for their doorstep concerns to be recorded. Thus, the final weights and replicate weights in the production data files would not be applicable

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APPENDIX A. Study sample

Table A1. Sample units excluded from study sample: without CHI records, never contacted, replacement units (This table is reproduced from Kopp et al. (2013)

Year-month	Number of sample units				Percent		
	Eligible	Without CHI	Without contacts	Replacement units	Without CHI	Without contacts	Replacement units
201110	4052	1	343	124	0.02	8.46	3.1
201111	4020	.	372	93	.	9.25	2.3
201112	4000	1	398	74	0.03	9.95	1.9
201201	4034	.	343	57	.	8.50	1.4
201202	4061	2	366	57	0.05	9.01	1.4
201203	3995	.	375	75	.	9.39	1.9
201204	4082	.	368	58	.	9.02	1.4
201205	4080	2	377	54	0.05	9.24	1.3
201206	3933	.	362	55	.	9.20	1.4
201207	4013	.	405	76	.	10.09	1.9
201208	4011	.	355	57	.	8.85	1.4
201209	4061	1	369	96	0.02	9.09	2.4
201210	4104	1	374	101	0.02	9.11	2.5
201211	4104	.	363	93	.	8.85	2.3
201212	4096	2	424	63	0.05	10.35	1.5
201301	4098	.	432	53	.	10.54	1.3
201302	4095	1	390	35	0.02	9.52	0.9
201303	4123	1	455	47	0.02	11.04	1.1

Note: there were 0 sample units with inconsistent ('no concern' + at least 1 concern') doorstep concern records attempt history.

Table A2. Descriptive statistics on continuous variables in Wave 1

Wave 1 variable	Survey nonresponse in Wave 1 (N=407)					Survey response in Wave 1 (N=2,953)					Overall (N=3,000)				
	Min	Max	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max	Mean	Median	SD
csize1 size sample unit	1	7	2.4	2	1.3	1	16	2.6	2	1.5	1	16	2.57	2	1.5
ncntct1 # contacts	1	17	2.5	2	1.6	1	9	1.9	2	1.1	1	17	2	2	1.2
cntatmp1 # attempts	1	55	8.6	8	5.2	1	33	4.4	3	3.4	1	55	5.0	4	3.9
ndaysatm1l1 # days1st and last attempt	1	31	21.8	25	8.5	1	31	10.5	8	8.6	1	31	12.0	10	9.4
pctcatmp1 % contacts/attempts	1.8	100	35.7	33.3	21.3	4.5	100	56.6	50	28.4	1.82	100	53.8	50	28.5
nstrg1 # strategies used	0	7	0.8	0	1.1	0	6	0.7	0	1	0	7	0.7	0	1.0
pctsftr1 % soft refusals	0	100	39.8	33.3	38.3	0	100	2.8	0	10.9	0	100	7.8	0	21.5

Note: median values of these variables from the "overall" group were used to create associated indicator variables shown in Table 2a.

APPENDIX B. Initial models attempted

Table B1. Logistic regression models attempted (Dependent variable: Wave 1 unit nonresponse=1; 0 otherwise)

	Model NoCHI				Model 1				Model 3 (selected as final)				Model 2			
	Logistic coeff	SE	Wald Chisq P	Std Est	Logistic coeff	SE	Wald Chisq P	Std Est	Logistic coeff	SE	Wald Chisq P	Std Est	Logistic coeff	SE	Wald Chisq P	Std Est
Intercept	-2.22	0.21	<.0001	_	-3.17	0.36	<.0001	_	-3.16	0.27	<.0001	_	-3.21	0.26	<.0001	-0.38
inoconc1					-1.38	0.25	<.0001	-0.38	-1.40	0.25	<.0001	-0.39	-1.39	0.25	<.0001	0.32
inh1					1.64	0.18	<.0001	0.32	1.65	0.18	<.0001	0.32	1.65	0.18	<.0001	0.02
icp1					0.12	0.17	0.465	0.03	0.11	0.17	0.522	0.03	0.10	0.17	0.559	-0.06
itime1					-0.20	0.17	0.240	-0.05	-0.23	0.16	0.162	-0.06	-0.23	0.16	0.157	0.02
igate1					0.14	0.22	0.515	0.02	0.13	0.22	0.558	0.02	0.13	0.22	0.570	0.17
ichgfrwv1					0.83	0.16	<.0001	0.17	0.83	0.16	<.0001	0.17	0.84	0.16	<.0001	-0.34
ipctcatmp1					-1.25	0.19	<.0001	-0.33	-1.26	0.19	<.0001	-0.34	-1.26	0.19	<.0001	0.29
indaysatm1l1					1.04	0.19	<.0001	0.29	1.04	0.19	<.0001	0.29	1.04	0.19	<.0001	0.22
ipctsftr1					1.15	0.18	<.0001	0.22	1.16	0.18	<.0001	0.22	1.16	0.18	<.0001	0.11
istrg1					-0.09	0.15	0.517	-0.03	-0.10	0.15	0.504	-0.03				
isglhunit1	0.30	0.15	0.044	0.08	0.57	0.20	0.006	0.14	0.43	0.17	0.012	0.11	0.44	0.26	0.011	-0.38
imsa1	0.27	0.18	0.137	0.05	0.11	0.24	0.659	0.02								
igpsize1	-0.41	0.12	<0.001	-0.11	-0.20	0.15	0.199	-0.05								
ihmowner	0.03	0.15	0.840	0.01	-0.20	0.20	0.309	-0.05								
N	2,583				2,583				2,583				2,975			
No. events	392				392				392				392			
No. profiles	16				283				424				283			
Overdispersion	0.7; 0.8				1.22				1.08 (p>0.1)				1.22 (p<0.01)			
-2LL	2298.8				1321.58				1324.38				1324.83			
AIC	2308.8				1351.58				1348.38				1346.83			
H&L test	Chisq=1.62, df=5, p=0.90				Chisq=14.17, df=8, p=0.07				Chisq=12.12, df=8, p=0.15				Chisq=13.30, df=8, p=0.10			
% Concordant	46.8				92.4				92.1				92.0			
% Discordant	33.4				7.6				7.6				7.4			
ROC area	0.57				0.92				0.92				0.923			

Comparison of nested models

Model 1 vs NoCHI	-2 log LR	AIC	Model 1 vs 3	-2 log LR	AIC	Model 3 vs 2	-2 log LR	AIC
Ho: model no CHI	2298.8	2308.8	Ho: model 3	1324.38	1348.38	Ho: model 2	1324.83	1346.38
Ha: model 1	1321.58	1351.58	Ha: model 1	1321.58	1351.58	Ha: model 3	1324.38	1348.38
chg -2LL	977.22		chg -2LL	2.8		chg -2LL	0.45	
df	10		df	3		df	3	
Chisq - p-value	0.0000		Chisq - p-value	0.4235		Chisq - p-value	0.9297	

Table B2. Estimated logistic coefficients of model with multiple interaction terms

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.1503	0.3369	87.4316	<.0001
inoconc1	1	-1.4231	0.3155	20.3507	<.0001
inh1	1	1.3414	0.3452	15.0979	0.0001
icp1	1	-0.1527	0.3151	0.2349	**0.6279**
itime1	1	-0.0516	0.2845	0.0330	0.8559
igate1	1	0.1374	0.2234	0.3781	0.5386
ichgfrwv1	1	0.8028	0.1566	26.2920	<.0001
ipctcatmp1	1	-1.2897	0.1899	46.1443	<.0001
indaysatm1l1	1	1.0633	0.1871	32.2859	<.0001
ipctsftr1	1	1.2127	0.1801	45.3187	<.0001
istrg1	1	-0.0867	0.1470	0.3480	0.5552
isglhunit1	1	0.4304	0.1719	6.2718	0.0123
inh1*icp1	1	0.8930	0.3460	6.6615	**0.0099**
inh1*itime1	1	-0.3379	0.3466	0.9503	0.3296
icp1*itime1	1	-0.1752	0.3493	0.2515	0.6160

Table B3. Comparing Model 3 with and without interaction term
(Dependent variable: Wave 1 unit nonresponse=1; 0 otherwise)

	Model with no CHI				Model 3 with interaction				Model 3 (final)			
Wave 1 predictors	Logistic coeff	SE	Wald Chisq P	Std Est	Logistic coeff	SE	Wald Chisq P	Std Est	Logistic coeff	SE	Wald Chisq P	Std Est
Intercept	-2.22	0.21	<.0001	_	-2.95	0.27	<.001		-3.16	0.27	<.001	_
inoconc1					-1.61	0.25	<.001	-0.44	-1.40	0.25	<.001	-0.39
inh1					1.11	0.18	<.001	0.21	1.65	0.18	<.001	0.32
icp1					-0.29	0.17	0.203	-0.07	0.11	0.17	0.522	0.03
itime1					-0.31	0.16	0.066	-0.08	-0.23	0.16	0.162	-0.06
igate1					0.11	0.22	0.622	0.02	0.13	0.22	0.558	0.02
ichgfrwv1					0.81	0.16	<.001	0.17	0.83	0.16	<.001	0.17
ipctcatmp1					-1.28	0.19	<.001	-0.34	-1.26	0.19	<.0001	-0.34
indaysatm1l1					1.06	0.19	<.001	0.29	1.04	0.19	<.001	0.29
ipctsftr1					1.21	0.18	<.001	0.23	1.16	0.18	<.001	0.22
istrg1					-0.10	0.15	0.487	-0.03	-0.10	0.15	0.504	-0.03
isglhunit1	0.30	0.15	0.044	0.08	0.43	0.17	0.012	0.10	0.43	0.17	0.012	0.11
imsa1	0.27	0.18	0.137	0.05								
igpsize1	-0.41	0.12	<0.001	-0.11								
ihmowner	0.03	0.15	0.840	0.01								
Inh1 * icp1					1.11	0.18	<.001	0.21				
N	2,583				2,583				2,583			
No. events	392				392				392			
No. profiles	16				424				424			
Model diagnostic statistics												
Overdispersion	0.7; 0.8				1.07 (p>0.16)				1.08 (p>0.1)			
-2LL	2298.8				1317.40				1324.38			
AIC	2308.8				1343.01				1348.38			
H&L test	Chisq=1.62, df=5, p=0.90				Chisq=18.63, df=8, p=0.02				Chisq=12.12, df=8, p=0.15			
% Concordant	46.8				92.2				92.2			
% Discordant	33.4				7.5				7.5			
ROC area	0.57				0.92				0.92			

Table B3. (continued) Comparing Model 3 with and without interaction term: odds ratios

	Model 3 (final)			Model 3 + interaction		
Variable	OR	95LCI	95UCI	OR	95LCI	95UCI
inoconc1	0.25	0.15	0.40	0.26	0.12	0.33
inh1	5.18	3.67	7.35			
icp1	1.11	0.80	1.55			
itime1	0.80	0.58	1.10	0.74	0.53	1.02
igate1	1.14	0.74	1.75	1.12	0.72	1.72
ichgfrwv1	2.29	1.69	3.11	2.26	1.66	3.06
ipctcatmp1	0.28	0.20	0.41	0.28	0.19	0.40
indaysatm1l1	2.82	1.97	4.08	2.88	2.01	4.18
ipctsftr1	3.18	2.25	4.50	3.34	2.35	4.75
istrg1	0.91	0.68	1.21	0.90	0.68	1.20
isglhunit1	1.54	1.11	2.16	1.54	1.10	2.16
icp1 at inh1=0				0.74	0.47	1.17
icp1 at inh1=1				1.84	1.12	3.03
Inh1 at icp1=0				3.04	1.79	5.14
Inh1 at icp1=1				7.50	4.77	11.79

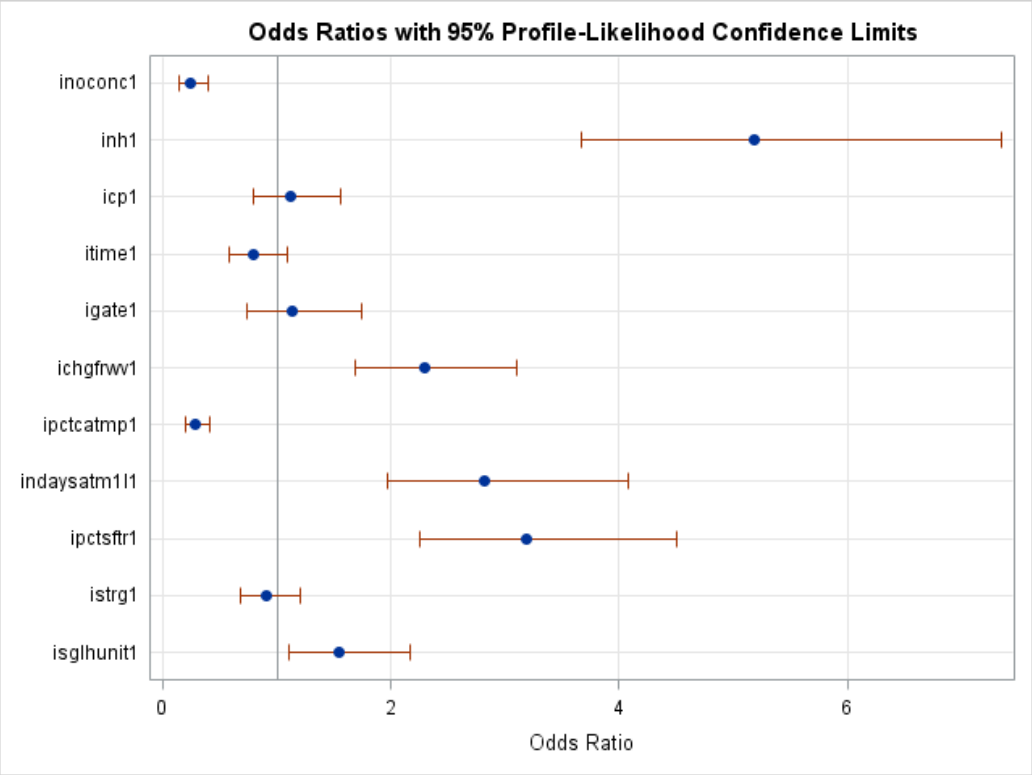
Table B4. Estimated parameters of final model (with interaction term) predicting survey nonresponse using one month of Wave 1 data outside the study period

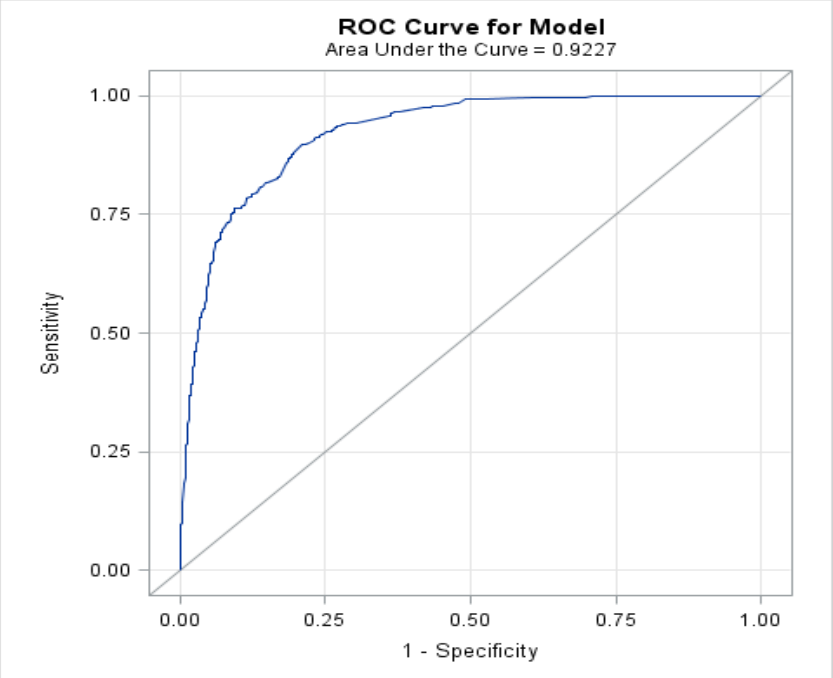
a. Parameter estimates

	Final model +intrx		2013m04 Wave 1		2013m7 Wave 1		2013m9 Wave 1	
Variable	Coeff	Wald Chisq p	Coeff	Wald Chisq p	Coeff	Wald Chisq p	Coeff	Wald Chisq p
intercept	-2.95	<.0001	-2.05	<.0001	-2.46	<.0001	-3.07	<.0001
inoconc1	-1.61	<.0001	-1.33	0.001	-1.88	<.0001	-0.93	0.03
inh1	1.11	<.0001	1.63	<.0001	0.23	0.55	1.07	0.03
icp1	-0.29	0.20	-0.06	0.85	-0.97	0.01	-0.18	0.63
itime1	-0.31	0.07	-0.33	0.22	-0.37	0.19	0.33	0.26
igate1	0.11	0.62	0.16	0.64	-0.54	0.18	-0.43	0.29
ichgfrwv1	0.81	<.0001	0.75	0.002	0.85	0.00	1.01	<.0001
ipctcatmp1	-1.28	<.0001	-0.54	0.03	-0.52	0.05	-0.32	0.21
indaysatm1l1	1.06	<.0001	1.39	<.0001	1.44	<.0001	1.72	<.0001
ipctsftr1	1.21	<.0001	1.51	<.0001	2.04	<.0001	1.93	<.0001
istrg1	-0.10	0.49	-0.45	0.05	0.31	0.21	-0.48	0.06
isglhunit1	0.43	<0.01	0.01	0.97	0.14	0.59	0.20	0.44
Inh1*icp1	0.90	<0.00	-0.13	0.81	2.11	0.00	0.58	0.34
N	2,583		757		783		718	
No. events	392		209		180		189	

	Final model			2013m04 Wave 1			2013m7 Wave 1			2013m9 Wave 1		
Variable	OR	95LCI	95UCI	OR	95LCI	95UCI	OR	95LCI	95UCI	OR	95LCI	95UCI
inoconc1	0.25	0.15	0.40	0.26	0.12	0.53	0.22	0.10	0.48	0.45	0.20	0.99
inh1	5.18	3.67	7.35	4.76	2.80	8.20	3.53	2.03	6.14	4.14	2.25	7.67
icp1	1.11	0.80	1.55	0.90	0.53	1.50	0.96	0.56	1.64	1.04	0.58	1.83
itime1	0.80	0.58	1.10	0.71	0.43	1.19	0.74	0.44	1.27	1.48	0.85	2.59
igate1	1.14	0.74	1.75	1.16	0.60	2.25	0.65	0.30	1.37	0.68	0.30	1.49
ichgfrwv1	2.29	1.69	3.11	2.11	1.30	3.41	2.42	1.46	4.02	2.73	1.66	4.49
ipctcatmp1	0.28	0.20	0.41	0.58	0.36	0.92	0.64	0.38	1.05	0.74	0.44	1.21
indaysatm1l1	2.82	1.97	4.08	4.02	2.30	7.30	4.19	2.30	7.92	5.66	3.04	11.16
ipctsftr1	3.18	2.25	4.50	4.55	2.62	7.98	6.27	3.47	11.50	6.48	3.49	12.31
istrg1	0.91	0.68	1.21	0.63	0.40	1.00	1.39	0.87	2.24	0.62	0.38	1.01
isglhunit1	1.54	1.11	2.16	1.01	0.62	1.64	1.07	0.64	1.78	1.19	0.72	2.01
N	2,583			757			783			718		
No. events	392			209			180			189		
% nonresponse	15.2			27.6			23.0			26.3		

Final model


Odds Ratios with 95% Profile-Likelihood Confidence Limits
inoconc1
inh1
icp1
itime1
igate1
ichgfrwv1
ipctcatmp1
indaysatm1l1
ipctsftr1
istrg1
isglhunit1
0
2
4
6
Odds Ratio


ROC Curve for Model
Area Under the Curve = 0.9227
1.00
0.75
0.50
0.25
0.00
Sensitivity
0.00
0.25
0.50
0.75
1.00
1 - Specificity

Classification Table (Final Model)

	Correct		Incorrect		Percentages				
Prob Level	Event	Non-Event	Event	Non-Event	Correct	Sensi-tivity	Speci-ficity	False POS	False NEG
0.000	392	0	2583	0	13.2	100.0	0.0	86.8	.
0.100	340	2096	487	52	81.9	86.7	81.1	58.9	2.4
0.200	296	2339	244	96	88.6	75.5	90.6	45.2	3.9
0.300	268	2416	167	124	90.2	68.4	93.5	38.4	4.9
0.400	232	2459	124	160	90.5	59.2	95.2	34.8	6.1
0.500	**204**	**2495**	**88**	**188**	**90.7**	**52.0**	**96.6**	**30.1**	**7.0**
0.600	181	2514	69	211	90.6	46.2	97.3	27.6	7.7
0.700	129	2540	43	263	89.7	32.9	98.3	25.0	9.4
0.800	84	2558	25	308	88.8	21.4	99.0	22.9	10.7
0.900	0	2582	1	392	86.8	0.0	100.0	100.0	13.2
1.000	0	2583	0	392	86.8	0.0	100.0	.	13.2

APPENDIX C. Final Model Diagnostics

Multicollinearity check

Table C1. Collinearity statistics

	Tolerance	VIF
inoconc1	0.78	1.29
inh1	0.83	1.20
icp1	0.88	1.14
itime1	0.91	1.10
igate1	0.93	1.08
ichgfrwv1	0.91	1.10
ipctcatmp1	0.96	1.04
indaysatm1l1	0.94	1.07
ipctsftr1	0.87	1.15
istrg1	0.98	1.02
isglhunit1	0.98	1.02

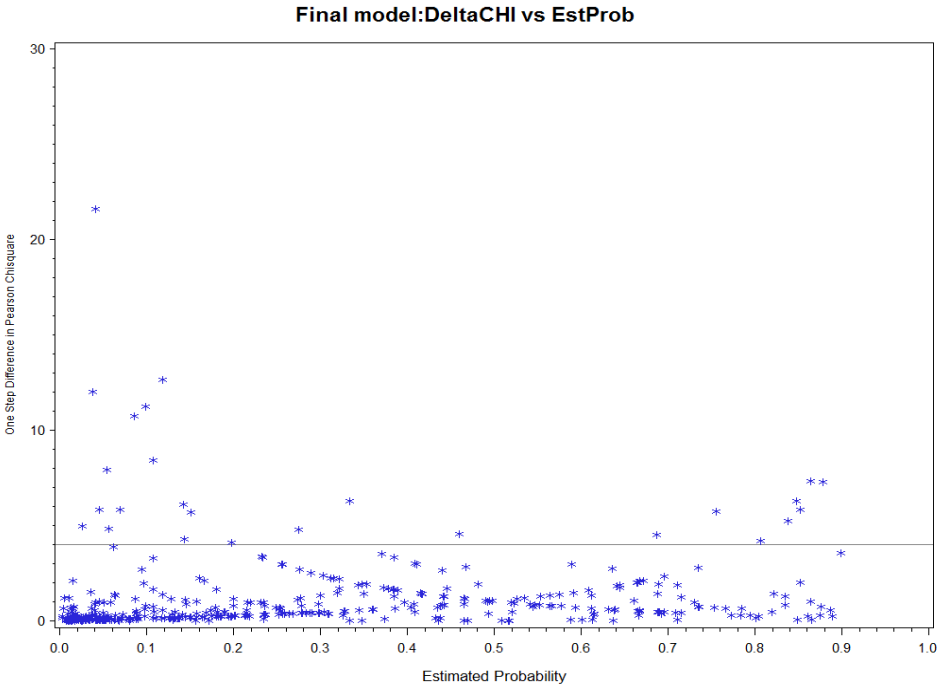
The maximum condition index value is 8 (for the 12th Eigenvalue); other index values vary between 1 and 4.

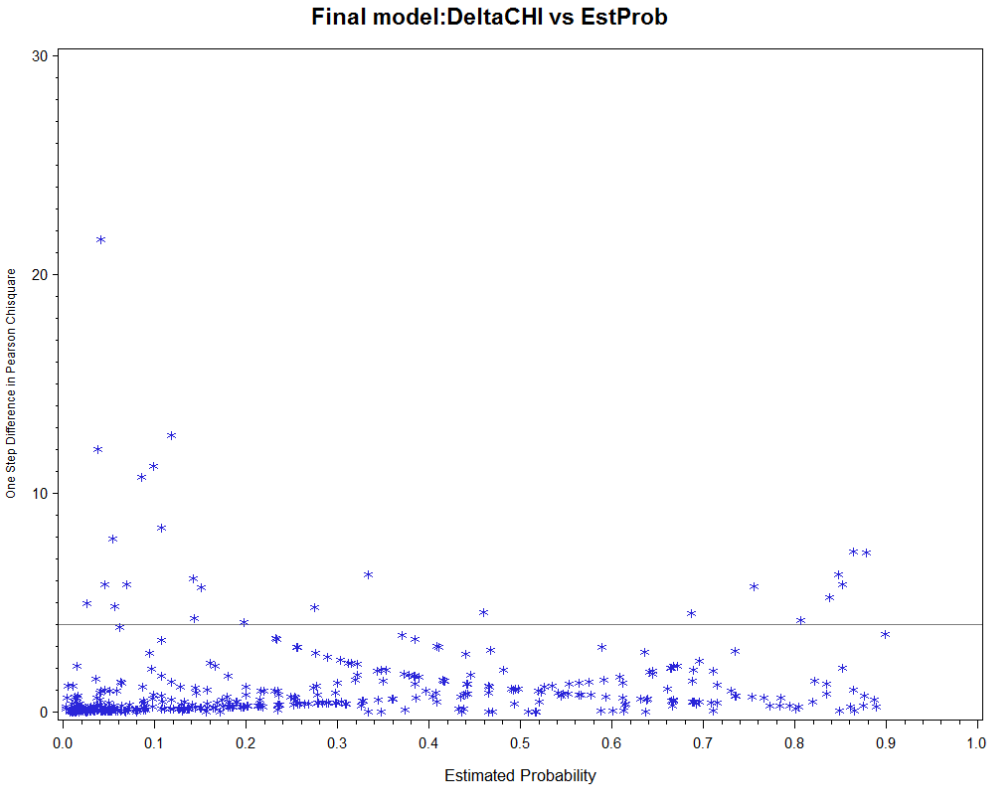
Table C1 (continued) Collinearity diagnostics: Proportion of variance

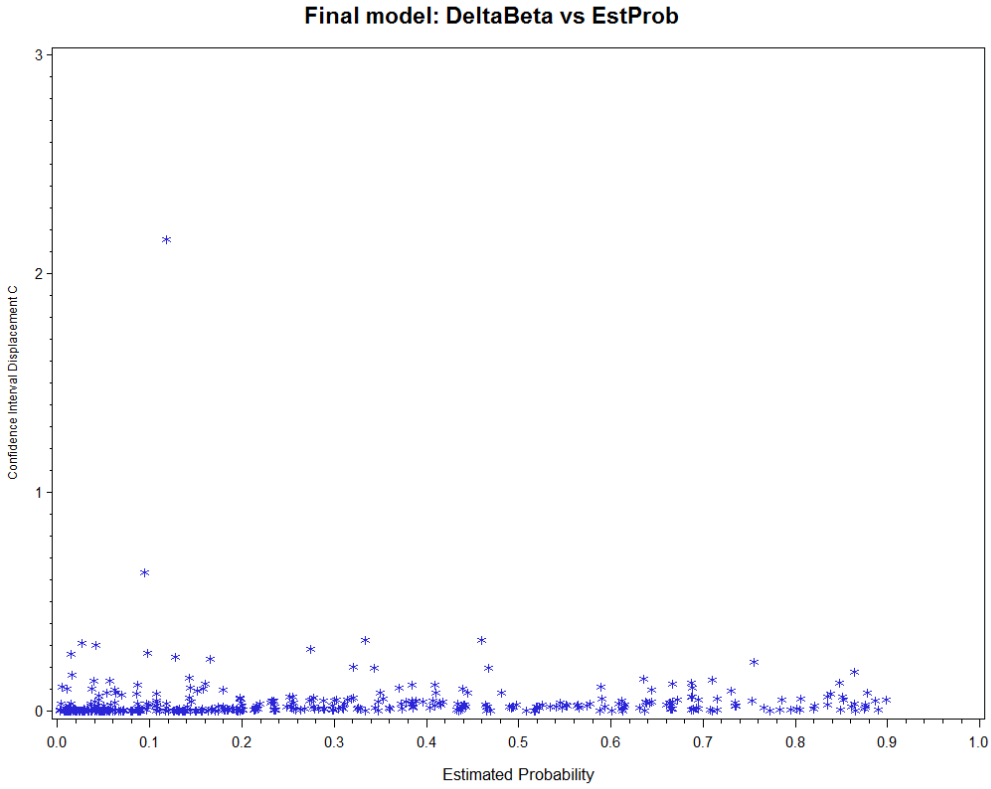
Number	Eigenvalue	Condition Index	inoconc1	inh1	icp1	itime1	igate1	ichgfrwv1	ipctcatmp1	indaysatm1l1	ipctsftr1	istrg1	isglhunit1
1	6.31	1	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2	1.12	2.38	0.51	0.02	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00
3	0.85	2.73	0.00	0.09	0.00	0.01	0.24	0.13	0.12	0.00	0.08	0.02	0.00
4	0.68	3.05	0.00	0.04	0.01	0.01	0.39	0.15	0.24	0.02	0.00	0.00	0.00
5	0.53	3.46	0.00	0.05	0.02	0.05	0.12	0.00	0.18	0.00	0.05	0.50	0.01
6	0.49	3.59	0.04	0.01	0.10	0.26	0.06	0.27	0.07	0.00	0.20	0.04	0.00
7	0.44	3.77	0.03	0.04	0.02	0.30	0.01	0.26	0.15	0.02	0.08	0.12	0.08
8	0.41	3.93	0.01	0.07	0.01	0.06	0.00	0.00	0.07	0.00	0.36	0.01	0.46
9	0.39	4	0.00	0.24	0.67	0.00	0.03	0.04	0.00	0.01	0.01	0.17	0.01
10	0.38	4.1	0.15	0.40	0.05	0.07	0.06	0.05	0.05	0.02	0.19	0.03	0.22
11	0.34	4.34	0.09	0.00	0.03	0.13	0.06	0.07	0.01	0.76	0.02	0.00	0.01
12	0.08	8.81	0.16	0.04	0.07	0.10	0.01	0.02	0.10	0.16	0.00	0.10	0.21

NOTE: variable descriptions can be found in Tables 2 (doorstep concern items) and 3 (all risk factors)

Diagnostic plots






Final model: DeltaBeta vs EstProb
Confidence Interval Displacement C
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Estimated Probability

Outlier covariate patterns

Table C2. Covariate patterns in Final Model with DeltaD or DeltaCHI > 4

covpat	inoconc1	inh1	icp1	itime1	igate1	ichgfrwv1	ipctcatmp1	indaysatm1l1	ipctsftr1	istrg1	isglhunit1	deltad	deltachi	deltabeta	estprob	events	trials
4	0	0	0	0	0	0	0	0	0	1	1	2.93	4.82	0.14	0.06	2	9
9	0	0	0	0	0	0	0	1	1	0	1	4.08	3.50	0.11	0.37	2	2
32	0	0	0	0	1	0	0	0	0	0	1	2.78	5.81	0.07	0.07	1	2
42	0	0	0	0	1	0	1	1	0	0	0	3.98	12.03	0.10	0.04	1	2
54	0	0	0	1	0	0	0	0	1	0	1	3.96	6.09	0.06	0.14	1	1
60	0	0	0	1	0	0	0	1	0	1	1	10.04	12.63	2.16	0.12	12	43
96	0	0	0	1	1	0	0	1	0	0	0	5.94	11.23	0.27	0.10	2	3
97	0	0	0	1	1	0	0	1	0	0	1	2.99	4.29	0.15	0.14	2	4
106	0	0	0	1	1	0	1	1	0	0	1	2.62	5.82	0.07	0.05	1	3
108	0	0	0	1	1	0	1	1	0	1	1	7.67	21.58	0.30	0.04	2	4
168	0	0	1	1	0	0	0	0	1	0	0	4.54	8.40	0.08	0.11	1	1
227	0	1	0	0	0	0	1	0	0	1	0	3.27	7.92	0.08	0.05	1	2
232	0	1	0	0	0	0	1	1	0	1	1	3.30	4.11	0.06	0.20	1	1
241	0	1	0	0	0	1	0	1	0	0	1	4.77	4.52	0.13	0.69	0	2
246	0	1	0	0	0	1	0	1	1	1	1	4.62	7.35	0.18	0.86	1	3
252	0	1	0	0	1	1	0	1	1	0	0	3.72	5.24	0.08	0.84	0	1
253	0	1	0	0	1	1	0	1	1	1	1	4.29	7.29	0.08	0.88	0	1
277	0	1	0	1	0	1	0	1	1	0	1	4.16	6.26	0.13	0.85	1	3
287	0	1	0	1	1	1	0	1	1	1	1	3.88	5.80	0.07	0.85	0	1
290	0	1	1	0	0	0	0	0	0	0	1	4.16	4.80	0.28	0.27	3	4
299	0	1	1	0	0	0	0	1	1	1	1	4.72	5.73	0.22	0.76	1	4
321	0	1	1	0	0	1	1	0	0	0	1	3.30	4.12	0.06	0.20	1	1
344	0	1	1	1	0	0	0	1	0	0	1	6.45	4.55	0.33	0.46	0	5
378	0	1	1	1	0	1	1	1	0	1	1	6.89	6.30	0.32	0.33	3	3
391	0	1	1	1	1	0	1	1	0	0	0	3.87	5.71	0.09	0.15	1	1
396	0	1	1	1	1	1	0	1	1	1	0	3.33	4.21	0.05	0.81	0	1
413	1	0	0	0	0	0	0	1	0	1	0	3.27	4.95	0.31	0.03	3	36
415	1	0	0	0	0	0	0	1	1	0	0	4.99	10.73	0.08	0.09	1	1

Table C3. Effect of excluding influential covariate patterns on adjusted odds ratios from the final model (model 3)

	Final model			Final model excluding covariate pattern 60			Final model excluding covariate pattern 246		
Variable	OR	95LCI	95UCI	OR	95LCI	95UCI	OR	95LCI	95UCI
inoconc1	0.25	0.15	0.40	0.27	0.16	0.44	0.24	0.14	0.39
inh1	5.18	3.67	7.35	5.43	3.83	7.73	5.31	3.75	7.53
icp1	1.11	0.80	1.55	1.23	0.87	1.73	1.07	0.76	1.49
itime1	0.80	0.58	1.10	0.74	0.53	1.03	0.77	0.56	1.07
igate1	1.14	0.74	1.75	1.21	0.77	1.86	1.12	0.73	1.73
ichgfrwv1	2.29	1.69	3.11	2.42	1.78	3.30	2.33	1.72	3.16
ipctcatmp1	0.28	0.20	0.41	0.29	0.20	0.42	0.28	0.19	0.40
indaysatm1l1	2.82	1.97	4.08	2.69	1.87	3.91	2.85	1.99	4.13
ipctsftr1	3.18	2.25	4.50	3.27	2.31	4.65	3.26	2.30	4.62
istrg1	0.91	0.68	1.21	0.83	0.62	1.11	0.93	0.70	1.24
isglhunit1	1.54	1.11	2.16	1.45	1.04	2.05	1.57	1.12	2.20
Overdispersion (p)	1.08 (p>0.1)			1.06 (0.18); 1.08(0.12)			1.07 (0.14)		
H&L p-value	0.15			0.03			0.12		
ROC curve	0.92			0.93			0.92		

Table C4. Final model excluding covariate patterns (60, 96, 290, 299, 344, 378, 413)

Variable	Estimate	StdErr	p	OR	95LCI	95UCI
Intercept	-3.27	0.29	<.0001			
inoconc1	-1.36	0.26	<.0001	0.26	0.15	0.43
inh1	1.71	0.18	<.0001	5.54	3.87	7.97
icp1	0.22	0.18	0.2169	1.25	0.88	1.77
itime1	-0.33	0.17	0.0578	0.72	0.52	1.01
igate1	0.11	0.23	0.6336	1.12	0.71	1.74
ichgfrwv1	0.84	0.16	<.0001	2.33	1.69	3.19
ipctcatmp1	-1.30	0.20	<.0001	0.27	0.18	0.40
indaysatm1l1	1.03	0.19	<.0001	2.79	1.92	4.11
ipctsftr1	1.27	0.18	<.0001	3.56	2.48	5.10
istrg1	-0.21	0.16	0.1822	0.81	0.60	1.10
isglhunit1	0.48	0.18	0.0082	1.61	1.14	2.30
Overdispersion (p)	1.04 (0.25)					
H&L p-value	0.12					
ROC curve	0.93					

Outside-sample estimation

Final model estimated using outside-study sample monthly data

Table C5. Parameter estimates of final model estimated using outside-study sample monthly data

	Model 3 (final)			2013m04 Wave 1			2013m07 Wave 1			2013m09 Wave 1		
	Logistic coeff	SE	Wald P	Logistic coeff	SE	P	Logistic coeff	SE	P	Logistic coeff	SE	P
intercept	-2.02		<.0001	-2.02		<.0001	-2.79		<.0001	-3.18		
inoconc1	-1.36	-0.39	<.0001	-1.36	-0.37	0.00	-1.52	-0.41	0.00	-0.81	-0.22	<.0001
inh1	1.56	0.32	<.0001	1.56	0.36	<.0001	1.26	0.28	<.0001	1.42	0.32	0.05
icp1	-0.11	0.03	0.522	-0.11	-0.03	0.68	-0.04	-0.01	0.88	0.04	0.01	**<.0001**
itime1	-0.34	-0.06	0.162	-0.34	-0.09	0.20	-0.30	-0.08	0.28	0.39	0.10	0.90
igate1	0.15	0.02	0.558	0.15	0.02	0.66	-0.43	-0.06	0.27	-0.38	-0.06	0.16
ichgfrwv1	0.75	0.17	<.0001	0.75	0.17	0.00	0.88	0.21	0.00	1.00	0.24	0.34
ipctcatmp1	-0.55	-0.34	<.0001	-0.55	-0.15	0.02	-0.45	-0.12	0.08	-0.31	-0.08	<.0001
indaysatm1l1	1.39	0.29	<.0001	1.39	0.38	<.0001	1.43	0.39	<.0001	1.73	0.47	0.23
ipctsftr1	1.51	0.22	<.0001	1.51	0.34	<.0001	1.84	0.40	<.0001	1.87	0.41	<.0001
istrg1	-0.46	-0.03	0.504	-0.46	-0.12	0.05	0.33	0.09	0.17	-0.48	-0.13	<.0001
isglhunit1	0.01	0.11	0.012	0.01	0.00	0.98	0.06	0.02	0.80	0.18	0.04	0.06
N	2,583			757			783			718		
No. events	392			209			180			189		
% Nonresponse	15.2			27.6			23.0			26.3		

Table C6. Parameter estimates of model 3 with interaction inh1*icp1

	Final model +interaction		2013m04 Wave 1		2013m07 Wave 1		2013m09 Wave 1	
Variable	Coeff	Wald Chisq p	Coeff	Wald Chisq p	Coeff	Wald Chisq p	Coeff	Wald Chisq p
intercept	-2.95	<.0001	-2.05	<.0001	-2.46	<.0001	-3.07	<.0001
inoconc1	-1.61	<.0001	-1.33	0.001	-1.88	<.0001	-0.93	0.03
inh1	1.11	<.0001	1.63	<.0001	0.23	0.55	1.07	0.03
icp1	-0.29	0.20	-0.06	0.85	-0.97	0.01	-0.18	0.63
itime1	-0.31	0.07	-0.33	0.22	-0.37	0.19	0.33	0.26
igate1	0.11	0.62	0.16	0.64	-0.54	0.18	-0.43	0.29
ichgfrwv1	0.81	<.0001	0.75	0.002	0.85	0.00	1.01	<.0001
ipctcatmp1	-1.28	<.0001	-0.54	0.03	-0.52	0.05	-0.32	0.21
indaysatm1l1	1.06	<.0001	1.39	<.0001	1.44	<.0001	1.72	<.0001
ipctsftr1	1.21	<.0001	1.51	<.0001	2.04	<.0001	1.93	<.0001
istrg1	-0.10	0.49	-0.45	0.05	0.31	0.21	-0.48	0.06
isglhunit1	0.43	<0.01	0.01	0.97	0.14	0.59	0.20	0.44
Inh1*icp1	0.90	<0.00	-0.13	0.81	2.11	0.00	0.58	0.34
N	2,583		757		783		718	
No. events	392		209		180		189	

Comparison of observed and predicted number of events

Table C8. Parameter estimates of Wave 1 nonresponse from final model covariates using outside-study sample data*

Variable	Estimate	SE	p-value (Chisq)	OR	95CLI	95UCI
Intercept	-2.47	0.15	<.0001			
inoconc1	-0.21	0.13	0.090	0.81	0.63	1.04
inh1	1.29	0.12	<.0001	3.62	2.87	4.56
icp1	-0.19	0.11	0.087	0.82	0.66	1.03
itime1	-0.27	0.11	0.014	0.76	0.61	0.95
igate1	0.04	0.16	0.819	1.04	0.76	1.40
ichgfrwv1	1.07	0.08	<.0001	2.91	2.48	3.41
ipctcatmp1	-0.04	0.08	0.638	0.96	0.83	1.12
indaysatm1l1	1.47	0.09	<.0001	4.36	3.66	5.20
ipctsftr1	1.57	0.12	<.0001	4.80	3.81	6.07
istrg1	-0.60	0.09	<.0001	0.55	0.46	0.65
iunitst1	0.04	0.08	0.587	1.04	0.89	1.22

* Wave 1 samples from April 2013 through Nov 2013

Table C8. Predicted number of Wave 1 nonresponse from final model covariates using outside-study sample data

Year-month	No. sample units	Observed no. nonresponse	Predicted no. nonresponse
201304	757	209	225
201305	745	167	204
201306	758	194	218
201307	783	180	219
201308	741	171	190
201309	718	189	206
201310	646	192	101
201311	764	217	157

ROC: 0.85

Classification Table

Prob Level	Correct Event	Correct Non-Event	Incorrect Event	Incorrect Non-Event	Percentages Correct	Sensi-tivity	Speci-ficity	False POS	False NEG
0.000	1519	0	4393	0	25.7	100.0	0.0	74.3	.
0.100	1431	2299	2094	88	63.1	94.2	52.3	59.4	3.7
0.200	1298	2926	1467	221	71.4	85.5	66.6	53.1	7.0
0.300	1007	3777	616	512	80.9	66.3	86.0	38.0	11.9
0.400	913	3920	473	606	81.7	60.1	89.2	34.1	13.4
0.500	666	4175	218	853	81.9	43.8	95.0	24.7	17.0
0.600	602	4241	152	917	81.9	39.6	96.5	20.2	17.8
0.700	516	4268	125	1003	80.9	34.0	97.2	19.5	19.0
0.800	392	4310	83	1127	79.5	25.8	98.1	17.5	20.7
0.900	193	4361	32	1326	77.0	12.7	99.3	14.2	23.3
1.000	0	4393	0	1519	74.3	0.0	100.0	.	25.7

APPENDIX D. Index to SAS Code

1. Create analysis file and supplemental outside-study sample Wave 1 data

……..\SAS\1_LR\Q1_CreateData.sas

- Create additional Wave 1 indicators for CHIRSCH wide file (n=3,000). These indicators indicate > median value of the source variables.
    - NOTE: CHIRSCH wide file was previously created for CHIRSCH project, see …\sas\1_LR\Copy_0_GetVars_2012RSCH.sas

……..\SAS\1_LR\Q1_GetVars_supplement2013m412.sas

- Get additional FAM + CHI data to "validate" model: extracted 2013 months 4-11 from Post-Phase 2
    - Data file created: ....\Data\Supp\wave1_2013supp.sas7bdat contains the Wave 1 data

2. Descriptive statistics

…….\SAS\1_LR\Q1_univariate.sas

- Produces table of descriptive statistics:
    - frequency distribution of single predictor by event outcome (wout1),
    - unadjusted OR with 95CI, and Wald Chi-sq p-value for parameter estimates from univariate logistic regression

3. Multivariate logistic regresssion

……\SAS\1_LR\Q1_MVLogisticRegr.sas

- Descriptive statistics on DS themes
- Creation of events-trials data structure for covariate patterns diagnostics
- Diagnostics on final model (model 3), using events-trials structure data
- Examined interaction terms between DS themes (freq distribution of combinations suggested differentiation in likelihood of nonresponse
- Compared observed and predicted counts from final model using outside-study sample data
- Final model w/interaction term: validation with monthly data 2013m4/m7/m9
    - Output: …..\1_LR\2014.02.21\
    - Check multicollinearity
    - Plots of DFstats * estProb

4. Compute predicted probabilities from final model by presence of DS Themes

……\SAS\1_LR\Q1_PredProb.sas