2015 CLEVELAND BRFSS METHODS REPORT

Contents

Introduction

This report describes survey implementation for the 2014 Cleveland Behavioral Risk Factor Surveillance Survey (Cleveland BRFSS), conducted on behalf of the Center for Prevention Research at Case Western Reserve University. The Cleveland BRFSS gathered data from Cleveland's adult residents about general health, food availability and consumption, and neighborhood quality. The data assessed the impact of the Healthy Cleveland Initiative, a city-wide policy intended to decrease the health disparities between Cleveland neighborhoods. The Cleveland BRFSS methodology is based on the Behavior Risk Factor Surveillance Survey (BRFSS), designed by the U.S. Centers for Disease Control and Prevention (CDC) to provide standardization among states conducting the survey.

The Center for Prevention Research contracted with ICF International, Inc. (ICF)—a firm specializing in survey research—to perform data collection for the Cleveland BRFSS. The Cleveland BRFSS was implemented from October 16, 2014 to January 19, 2015. Data collection was conducted via landline and cellular telephone surveys. Landline interviews were conducted with randomly-selected adults in randomly-selected, telephone-equipped households in Cleveland. Cellular telephone interviews were conducted with adults living in the city of Cleveland, who were classified as "cell-mostly" users. "Cell-mostly" users are individuals with no landline telephone, or those who have a landline telephone, yet receive at least 90 percent of their calls on their cell phone. This dual-frame survey implementation targeted the desired population with these objectives:

- 1,125 landline completes, and
- 1,125 cell phone completes.

ICF conferred regularly with the Center for Prevention Research during the course of the survey. The project began with an initial meeting designed to clarify expectations and provide an opportunity to discuss project details. ICF regularly informed the Center for Prevention Research of the project's progress via daily Web portal reports, and e-mail and telephone communications. The Cleveland BRFSS Web portal reports offered the following information on survey progress for both the landline and cell phone components:

- CDC dispositions,
- Response rates,
- Average interview length,
- Completes by gender,
- Completes by neighborhood, and
- Completes by language.

Population and Sample Design

Population

The Cleveland BRFSS measured the non-institutionalized adult (ages 18 and over) population within the City of Cleveland. This population excluded adults: (1) in penal, mental, or other institutions; (2) living in other group quarters (with 10 or more unrelated residents) such as dormitories, barracks, convents, or boarding houses; and (3) contacted at their second dwelling unit during a stay of less than 30 days. It also excluded those adults living in the suburbs of Cleveland, rather than within the city limits.

Sample Design

To reach Cleveland's adult (non-institutionalized) population, the Cleveland BRFSS was based on a dual-frame sampling design including:

- A two-stage stratified, list-assisted, random digit dialing (RDD) sample of adults in telephone equipped households; and
- A sample of "cell-mostly" users selected from a RDD sample of cell phone numbers.

Landline Sample Design

The landline sample involved two stages. The first stage was creating a list-assisted, stratified RDD sample of telephone-equipped Cleveland households. The list-assisted sample assured that Cleveland households with listed and unlisted telephone numbers were eligible to be selected for the survey.

Stage One: List-assisted RDD samples were generated by first preparing, and then maintaining, an up-to-date list of all current thousand-blocks, or the first seven digits of a 10-digit telephone number, in which at least 25 percent of assigned phone numbers were associated with a zip code within Cleveland. These telephone thousand-blocks, when combined with all three-digit numbers from 000 to 999, constitute the set of all possible working telephone numbers, both residential and non-residential.

After mapping the telephone thousand-blocks, all possible telephone numbers were then divided into blocks (or banks) of 100 numbers. A 100-block is the series of 100 telephone numbers defined by the last two digits of a 10-digit phone number. For telephone numbers with the first eight digits in common, there are 100 possible combinations of the last two digits (ranging from 00–99)—this is one 100-block. To greatly enhance efficiency (and reduce costs) zero-blocks, or 100 blocks without any assigned telephone numbers (called zero-blocks), were excluded (or truncated) from the sampling frame. The exclusion of zero-blocks reduced the frame coverage, but considerably increased productivity. The remaining 100-blocks, those with at least assigned residential number (or 1+ blocks), comprised the sampling frame—referred to as a truncated, landline assignment-based frame since listed telephone numbers help in improving sampling efficiency. This procedure assured that both listed and unlisted

numbers were sampled. The landline sample for each county based stratum was drawn using an in-house RDD sampling system, called the Genesys system from MSG, Inc.[1]

Stage Two: Within stratum, telephone numbers were then stratified into either a *high-density* or *low-density* substratum based on whether the number could be matched to an assigned address. Telephone numbers assigned to addresses are most often working residential numbers, whereas telephone numbers which are unable to be matched include non-working and non-residential telephone numbers. To leverage this information, ICF oversampled telephone numbers in the high-density stratum at a 1.5:1 ratio relative to the low-density stratum. This oversampling increased the sampling efficiency by raising the percentage of working residential numbers selected in the sample. ICF used a *double-sampling approach* to the density stratification, where an RDD sample was drawn, matched to a database of listed telephone numbers, assigned to the appropriate stratum, and then sub-sampled. To further increase sampling efficiency, telephone numbers which were assigned to zip codes outside of Cleveland were eliminated from dialing.

Landline survey sample was loaded in three waves:

- Wave 1:
  - October 16, 2014: 20,748 records
- Wave 2:
  - October 28, 2014: 35,393 records
- Wave 3:
  - November 22, 2014: 44,704 records
- Total landline sample: 100,845 records

Cell Phone Sample Design

ICF purchased cell phone sample from MSG, Inc. Cell phone sample was generated within thousand series blocks (first 7 digits of the phone number) that were dedicated to providing wireless service in rate centers associated with Cleveland. Cell phone numbers that were contained in mixed-use banks (landlines and cellular lines) were not included in the cell phone sample frame. The sample generation was an Equal Probability of Selection Method (EPSEM) sample where every possible number had an equal probability of selection.

In order to maximize sample productivity, ICF requested that MSG, Inc. append the zip code of the billing address to telephone numbers whenever possible, and subsampled cell phone numbers based on whether the numbers matched to a zip code within Cleveland, outside of Cleveland, or if no zip match was possible. All cell phone numbers matching to zip codes within Cleveland were selected. Cell phone numbers matched to a zip code outside of Cleveland were subsampled by a factor of 4. Cell phone numbers that were unsuccessfully matched to a zip code were considered less likely to be working numbers. However, if an unmatched number was found to be working it was expected to be more likely to belong to a Cleveland resident than a number matched to a zip code outside of Cleveland. Thus,

[1] ICF has an unlimited license for using the Genesys system. The Genesys frame is updated quarterly using the Bell Communications Research (BELLCORE) valid area code-exchange database and keyed residential and business listings from major providers.

unmatched numbers were subsampled by a factor of 1.5. Cell phone numbers were manually dialed to comply with the Telephone Consumer Protection Act (TCPA).

Cell survey sample was loaded in three waves:

- Wave 1:
  - October 24, 2014: 9,083 records
- Wave 2:
  - November 24, 2014: 53,799 records
- Wave 3:
  - December 23, 2014: 4,176 records
- Total cell phone sample: 67,058 records

Questionnaire Development

The 2014 Cleveland questionnaire was based on the 2009 Cleveland BRFSS questionnaires and the CDC BRFSS core questionnaire. The Cleveland BRFSS obtained detailed data on general health status, neighborhood attributes and safety, transportation, food quality and security, demographics, tobacco use, alcohol use, and eating and exercise habits. The questionnaire was divided into the following sections:

- Introduction and Screening
- Health Status
- What's in Your Neighborhood
- Food and Financial Security
- Social Support
- Hope for the Future
- Demographics
- Inadequate Sleep
- Tobacco Use and Quit Intentions
- Secondhand Smoke Exposure
- Alcohol Consumption
- Fruits and Vegetables
- Exercise
- Address/Intersection
- Closing thanking respondents for their time.

The questionnaire contained many of the questions in the Core sections of the 2013 and 2014 BRFSS questionnaires from the CDC. It also contained questions that came from the 2009 Cleveland Steps to a Healthier Cleveland BRFSS questionnaire, which were derived from the 2009 Core BRFSS questions. Additionally, questions were added that targeted neighborhood-specific practices and that were intended to examine the impact of the Healthy Cleveland Initiative. These questions were integral to the information the Center for Prevention Research was trying to obtain about the health of Cleveland residents and about Cleveland neighborhoods. The 2014 Cleveland BRFSS questionnaire can be found in Appendix A, and a compilation of the source of each section of the questionnaire can be found in Appendix B.

Interviewer Training

The following section describes interviewer training, including ICF basic interviewer training, Cleveland BRFSS project-specific training, and Cleveland BRFSS training tools.

Training Manual and FAQ Development

ICF project management staff created a Cleveland BRFSS training manual and FAQ sheet for interviewers. The training manual, included in Appendix C, contains information about the survey's background, purpose and scope, population, dialing protocols, and other relevant project information. The FAQ sheet, included in Appendix D, contains preemptive refusal aversion statements designed to address respondent concerns, as well as responses to more general respondent questions, such as how phone numbers are selected.

Training

Interviewer training included two phases: basic training and Cleveland BRFSS-specific training.

Basic Training

Cleveland BRFSS interviewers, as is standard for all ICF interviewers, participated in a two-day general interviewer training upon hire, prior to conducting interviews on any survey. Basic interviewer training included an overview of the following:

- Survey research techniques,
- Telephone surveys,
- The role of the interviewer in survey research,
- Types of samples,
- Types of respondents,
- Determining household and respondent eligibility, and
- An introduction to ICF's CATI system via practice interviews.

During basic training, interviewers also learned techniques such as: reading questions, entering responses, probing for responses, using appropriate feedback, and avoiding refusals. Interviewers were taught techniques for handling difficult respondents, probing for answers in challenging situations, and converting refusals. At the conclusion of each day of training, new interviewers were given a test before being able to continue with the training.

Cleveland BRFSS-Specific Training

Cleveland BRFSS interviewers were selected from ICF's pool of existing interviewers and specifically chosen for their experience on other BRFSS studies (many of which are also conducted by ICF) and other CDC studies. ICF project management staff conducted an initial interviewer training on October 16, 2014.

Training topics included:

- Survey background and context, including survey purpose and scope;
- Overview of survey population, sample, and sample design;
- Dialing protocol, response rates, and achieving high response;
- Review of survey characteristics, such as the expected survey length, methodology, use of caller ID and Interactive Voice Response (IVR) help desk information;
- Review of the questionnaires, including topics covered by the survey with a focus on challenging and unique questions, differences between landline and cell phone questionnaire instruments, and the purpose/context of key questions;
- Review of FAQ and how to respond to common respondent questions; and
- Discussion of refusal protocol, and refusal aversion and conversion techniques.

There was also time for interviewers to ask questions, with answers provided by ICF Project Management.

Prior to dialing on the Cleveland BRFSS, interviewers conducted mock interviews using the CATI system to gain project-specific experience with questionnaire flow, data entry mechanics, and terminology.

Ongoing Training

During fielding, ICF's quality assurance (QA) staff and project management staff evaluated all interviewers on the project via monitoring sessions. Such monitoring sessions included both past interviews that had been recorded and live interviews in-progress. QA staff and call center supervisors coached interviewers on an individual basis based on feedback from the monitoring sessions. If, after coaching, an interviewer's performance did not improve, he or she was removed from working on the study.

Due to issues with collecting respondent neighborhood information, an additional mid-field training was scheduled to more thoroughly review how to ask for and record respondent neighborhood. There were multiple subsequent refresher trainings about this topic, and a specialized training manual, Residency and Neighborhood, was developed and can be found in Appendix E.

Data Collection

This section details the data collection phases of the 2014 Cleveland BRFSS.

Overall Completes by Target

The combined cell and landline studies obtained the following targets, shown in *Tables A* and *B* below.

Table A: Total Completes

Mode of Calling		
Cell	**Landline**	**Total**
1028	1160	2188

Table B: Total Completes and Partial Completes

Mode of Calling		
Cell	**Landline**	**Total**
1215	1307	2522

Table C: Completes by gender (Completes Only)

Gender	Mode of Calling	
	Cell	**Landline**
Male	476	367
Female	552	792

Table D: Completes by gender (Completes and Partial Completes)

Gender	Mode of Calling	
	Cell	**Landline**
Male	575	414
Female	640	893

Survey Length

The survey length, broken down by calling mode is shown in *Table E*.

Table E: Survey length by mode

Mode	Minutes
Cell	26.5
Landline	26.6

Screeners and Respondent Selection

For the landline instrument, interviewers asked how many adults over age 18 are residents of the household. Then, they asked how many of these individuals are male, and how many are female. (In a single adult household, interviewers asked, "Are you that person?" and if the adult is a man or a woman, if necessary.) Once the information is entered, the computer randomly selected one person to be interviewed.

The cell phone survey instrument utilized just one screener that confirmed an adult and cell-mostly status. Additionally, respondents were asked if they were in a safe place to be on the phone (i.e. not driving).

Dialing Protocol

Landline dialing protocol and day-part attempts were as follows:

- Weekdays: Monday – Friday: 9:00 a.m. – 5:00 p.m.: three attempts.
- Weeknights: Monday – Friday: 5:00 p.m. – 9:00 p.m.: three attempts.
- Weekends: Saturday and Sunday: 10:00 p.m. – 9:00 p.m.: three attempts.
- Six any-time attempts made during weekends or week nights

Cell phone sample dialing protocol and day-part attempts were as follows:

- Weekdays: Monday – Friday: 9:00 a.m. – 5:00 p.m.: two attempts.
- Weeknights: Monday – Friday: 5:00 p.m. – 9:00 p.m.: three attempts.
- Weekends: Saturday and Sunday: 10:00 p.m. – 9:00 p.m.: three attempts.

Contacting Respondents

The following protocols were followed when contacting households and potential respondents.

Treatment of No Answers. If a call to a sampled telephone number was not answered, the number was repeatedly called at different times, during day-time and evening hours (9 a.m. to 9 p.m. Monday through Friday; 10 a.m. to 9 p.m. Saturday and Sundays), on different days of the week, in a pattern designed to maximize the likelihood of contact with a minimum number of calls. At least 15 contact attempts for the landline sample, and six attempts for the cell phone sample, were made to reach a sampled number.

Rings per Attempt. The telephone rang a minimum of five times on each attempt made on a record.

Busy Lines. Busy lines were called back at least twice at 10-minute intervals. If the line was still busy after the third attempt, the number was assigned a "busy" disposition and called during the next shift.

Respondent Selection. Once a household was contacted, an adult was selected for participation in the study. No interview was conducted if:

1) The adult was:

- Unavailable during the survey period or
- Unable or unwilling to participate.

2) A randomly sampled number yielded:

- A business,
- An institution,
- Group quarters, or
- Other strictly non-residential space.

3) The number was an occupant's second residence and his or her stay there was fewer than 30 days.

Language of Interviewing. Interviews for the Cleveland BRFSS were conducted in both Spanish and English. If the contacted respondent did not speak English, the record was dispositioned as a language barrier, at which point the record was moved into the Spanish study. Bilingual interviewers called on that study to complete surveys in Spanish.

Converting Initial Refusals - Landline. Protocol for the 2014 Cleveland BRFSS followed the Behavioral Risk Factor Surveillance System (BRFSS) refusal protocol. Landline refusals were distinguished between a selected respondent refusal versus a non-selected respondent refusal. There were two attempts to convert respondents who had been selected for participation and three attempts made to households where no one been selected for participation. After the first selected respondent refusal, the record was transferred to a special refusal study that employed the best interviewers in order to encourage participation. The same was done after the second non-selected respondent refusal. Refusal study calls were generally not made until at least 48 hours after the initial refusal.

Converting Initial Refusals – Cell Phone. The cell phone refusal conversion protocol differed from the landline survey protocol. Records with a refusal disposition were moved to a special refusal type that only refusal conversion interviewers dialed. If a respondent refused a second time, while in the special refusal type, the record was coded as a hard refusal.

Contacting Cell Phone Respondents. Dialing on cell phone sample required additional interviewer training. Interviewers were trained to ensure that a respondent was in a safe situation to be on his or her cell phone. If a respondent was driving or indicated that the call came at an inconvenient time, a call-back was scheduled.

Strategies to Improve Response Rates

ICF employed several strategies to increase the response rate. This section describes those strategies.

Refusal Conversion

In order to help convert refusals into completes, ICF project staff created several Center for Prevention Research-approved refusal conversion statements. These statements were included in the interviewer FAQ and in the special help screen accessible to interviewers at any point during the survey. Additionally, records receiving an initial refusal were called on by interviewers trained specifically for refusal conversion.

Respondent Help Desk

ICF programmed an inbound IVR system with pre-recorded messages about the Center for Prevention Research. Calls to the toll-free number were seamlessly routed to the IVR. The IVR offered the following menu options:

- Learn more about the study;
- Speak directly to a call center supervisor; and
- Leave a message (*e.g.*, request removal from calling, set up an appointment, *etc.*).

If a respondent chose to speak to a call center supervisor, he or she was routed to a supervisor in the ICF call center who answered respondent questions, routed respondents for interview, scheduled call-backs, or removed respondents from calling. The IVR script appears in Appendix E.

Caller ID

Some landline telephone users have automatic software on their phones that prohibits calls from unidentified numbers. To ensure reaching people with these "call block" systems, ICF broadcasted a caller ID number. For this study, the following number was used: 802-861-3907. The text "ICF International" was broadcast with this number. Any calls to this number were routed to a toll-free number (so respondents would not incur charges) and to the Respondent Help Desk, or IVR system.

Quality Control and Assurance Measures

For the 2014 Cleveland BRFSS, ICF followed stringent quality assurance steps to ensure the instrument, interview quality, and data processing meet client expectations. *Table E*, shown below, outlines the quality control measures ICF employed in an effort to eliminate errors and standardize procedures.

Table E: ICF quality control measures

TASK	Telephone Data Collection Quality Control Measures
CATI Program Testing	• Test each response to each question, and each path through the survey • Review frequencies from randomly-generated data to ensure that the program is organizing data properly and recording values according to the survey specification • Develop skip-check program to check data against defined conditions specified in the Microsoft Word version of the questionnaire • Provide the VDH with an electronic test version of the programmed survey
Interviewer Training	• Dedicated team of Cleveland BRFSS interviewers • General 12-hour training • Cleveland BRFSS training led by ICF project management, subsequent trainings led by Call Center Supervisory staff
CATI Quality Assurance	• Call center monitors at least 10 percent of all interviews (10% sample) • Professional project staff monitor Cleveland BRFSS interviews (10 per week) • Assign supervisors to manage a team of no more than 10 interviewers • Review call center shift reports and internal project tracking reports daily • Review of data alerts indicating something went awry and fixing any issues
Preparation of Data Files	• Identify incomplete interviews and merge back into the main data file (100%) • Clean and back-code open-ended responses as specified by the Center for Prevention Research • Assign a final disposition to each record • Produce frequency tabulations of every question and variable to detect missing data or errors in skip patterns
TASK	**Weighting**
Weighting	• Independent review of the weighting code by a second sampling statistician • Check range and values of adjustments; evaluate selection probabilities • Independent review of definitions of variables used in weighting

Response Rates

Response rates provide a measure of interviewing success. ICF applied the Council of American Survey Research Organization's (CASRO) response rate formula for the Cleveland BRFSS. The response rate formula and calculation can be found in the Response Rate Formulas Appendix G. Response rates for the landline and cell phone surveys are presented below.

Mode	Old CASRO Formula	New CASRO Formula	Resolution Rate	Cooperation Rate	Refusal Rate	Interview Completion Rate
Landline	44.8%	30.6%	89.2%	34.3%	23.7%	56.3%
Cell	29.9%	29.5%	41.7%	70.8%	10.9%	73.1%

The difference between the Old CASRO formula and the New CASRO formula is the treatment of disposition 2220, answering machine, definite residence. Prior to 2012, this disposition was categorized as eligibility unknown. The CDC BRFSS response rates were updated in 2012 and disposition 2220 was re-categorized as known eligible.

Data Processing and Weighting

Cleveland Data Processing

Data processing for Cleveland BRFSS was comprised of three functions: (1) *converting* the raw telephone data into a user-friendly data file; (2) performing a *quality review* of the data; and (3) *formatting* the data to the Center for Prevention Research specifications.

Converting the Telephone Data

The first step was to identify incomplete interviews, defined as interviews which do not answer through the last survey question. The next step was to review responses to open-ended questions, and to back-code these responses per Center for Prevention Research specifications. A number of questions allow the respondent to choose "other" as a response category, with the interviewer then recording a verbatim response. The final step in preparing the data involved assigning a final disposition to each record (both completed and incomplete interviews); ICF has automated this process with a program that reviews the call history for every record and assigns a final disposition based on the CDC's rules.

Quality Review

After converting and cleaning the data, ICF produced frequency tabulations of every question and variable to detect missing data or errors in skip patterns. ICF also ran customized SAS (SAS is a statistical software package) programs (called "skip check" programs) designed specifically by our programmers for each survey. For each question, responses outside of the expected range were flagged. Checks were also performed across questions to evaluate consistency. The customized SAS programs were written at the start of each new questionnaire cycle and run daily as part of the overnight quality control process.

Cleveland BRFSS Weighting

The Cleveland BRFSS includes a general population sample of adults (18 years and older). The general population sample was a cell phone and landline dual-frame. In the landline survey, one adult was selected at random from all eligible adults in the household.

We weighted the data in three steps:

1. Develop base weights;
2. Combine the landline with the cell sample; and
3. Poststratify and adjust the sample to match the population.

Base Weights

The landline RDD sample was stratified proportionally by county. It was then assigned randomly to either the base sample or oversample. Within each county, approximately 10 percent was assigned to the base sample and 90 percent was assigned to the oversample.

Landline telephone numbers were compared to local residential telephone directories and numbers that were found to be listed to zip codes within Cleveland were oversampled at a rate of 1.5:1 compared to unlisted numbers. This was based on a two phases sampling process in which we select a sample (n*) from all records on the frame (NRECSTR), match the sample to determine listed status, stratify as listed/unlisted and then select a subsample (n) from each stratum. The weight is the product of the initial sampling weight and the subsampling weight, $W1 = (NRECSTR/n^{*})\times(n_j^{*}/n_j)$. Landline selection weights are shown in *Table 1.*

Households with more than one landline telephone number have multiple opportunities to be selected. Since each landline phone number has an equal probability of selection, the weight for household selection w_2 is computed as w_1 divided by the number of landline phone numbers in the household. This adjustment was capped at a maximum of three landline phone numbers per household.

One adult is selected from the household is selected randomly with equal probability. The final base weight w_3 is computed as w_2 times the number of adults in the household. The adjustment for adult selection was capped at a maximum of three adults per household.

Table 1: Landline Base Weights

STRATUM	Sample	NRECSTR	STATUS	n*	n	W1
Landline	**10/15**	1056400	**Cleveland Zip**	10,445	10,445	11.67
			Unmatched	68,295	45,506	17.52
	11/22	709700	**Cleveland Zip**	10,620	10,498	10.86
			Unmatched	51,446	34,206	16.15

Similarly, cell phone numbers were matched to a billing zip code whenever possible and stratified as matched to a Cleveland zip code, unmatched, or matched to a zip code outside of Cleveland. A sample of cell phone numbers was selected from each stratum. It was assumed that each respondent only had one cell phone number, and each cell phone number was only used by one adult. Thus, the adjustments for adult selection and number of phone numbers owned were both equal to 1.

Table 2: Cell Base Weights

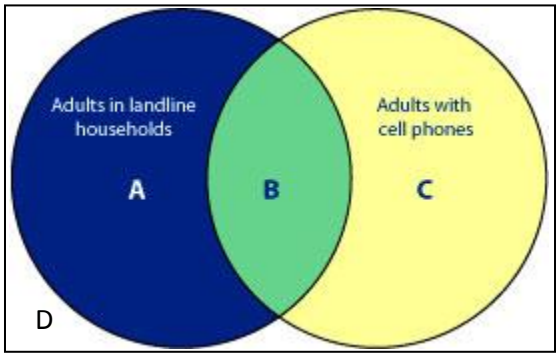
NRECSTR	Rate Center	STATUS	n*	n	W1
1,975,000	**Cleveland Rate Center**	**Cleveland Zip**	16,160	16,160	15.83
		Unmatched	45,247	30,180	23.74
		Non-Cleveland Zip	52,915	13,200	64.47
	Independence/ Montrose/ Terrace Rate Centers	**Cleveland Zip**	858	858	15.83
		Unmatched	4,809	3,210	23.72
		Non-Cleveland Zip	1,748	450	61.50

Combining Cell Phone and Landline Samples

The Venn diagram below displays three populations covered by the cell and landline sampling frames. Adults with a landline but no cell phone (A) must be reached through a landline telephone sample. Adults with a cell phone and no landline (C) must be reached through the cell phone sample. Adults with both a landline and a cell phone (B) can be reached through either of the frames. The population with

no telephone (D) is not covered by either frame, but is only about 2% of the population as seen in the table below.

Figure 1: Population Coverage by Cell and Landline Sampling Frames



Since the cell phone frame and the combined landline frame overlap, we have the following sample groups:

a_1: Landline respondents without a cell phone,

b_1: Landline respondents with a cell phone,

b_2: Cell phone respondents with a landline, and

c_2: Cell phone respondents without a landline.

To determine group membership, the cell phone survey asks, "Do you also have a landline telephone in your home that is used to make and receive calls?" Those who responded "yes" are classified as cell and landline adults, while those who responded "no" are classified as cell-only adults. Similarly, landline survey asks, "In addition to your residential landline telephone, do you also use one or more cell phone numbers?" Those who answered "yes" are classified as cell and landline, while those who responded "no" are classified as landline-only.

After determining the telephone groups, each is independently weighted to benchmarks for the population they are meant to represent. This is done for two reasons: 1) dual-users are overrepresented since they are eligible in both samples, and 2) differential response rates between dual-users and cell-only respondents in the cell phone sample. The benchmark for the phone groups is the National Health Interview Survey (NHIS). The NHIS is an in-person household survey that collects information about cell phone and landline availability. It provides national estimates of the cell-only population, the landline-only population, and the dual-user population.

The NHIS estimates of phone status were based on small area modeling for Cuyahoga County, Ohio, of data collected from January 2007-December 2012[2].

2 Blumberg SJ, Ganesh N, ,Luke JV, et al. Wireless substitution: State-level estimates from the National Health Interview Survey, 2012. National health statistics reports; no 70. Hyattsville, MD: National Center for Health Statistics. 2013.

Table 3: Percentage of Population by Phone Status

Category	Percent
Cell only (A)	38.1
Dual (B)	53.9
Landline only (C)	6.1
No phone (D)	1.9

After weighting to NHIS, we have two independent estimates of the dual-user group, one from cell and one from landline. To combine the two estimates, we averaged the two sets of weights (both are weighted to the population) with a composite weight based on sample size and estimated design effect:

$f = \frac{b_1/deff_1^2}{b_1/deff_1^2 + b_2/deff_2^2}$, where $deff_1 = b_1 \sum_{b1} w_3^2 \times \left[\sum_{b_1} w_3\right]^{-2}$

In summary, for each weighting cell, $w_4 = w_3 \times PS \times f$.

Table 4: Calculations for Combining Landline with Cell Phone

	Sample Size	Population (NHIS)	Ratio Adjustment (*PS*)	Composite Weight (*f*)
Landline respondents with no cell phone	a_1	A	$A/\sum_{a_1} w_1$	1
Landline respondents with a cell phone	b_1	B	$B/\sum_{b_1} w_1$	f
Cell phone respondents with a landline	b_2	B	$B/\sum_{b_2} w_1$	$1-f$
Cell phone respondents without a landline	c_2	C	$C/\sum_{c_2} w_1$	1

Poststratification and Population Adjustments

As a final step, we ratio-adjusted the combined samples to match the population. The population data was based on the American Community Survey 2013 estimates for Cleveland City except for phone ownership which was based on the percentages reported in Table 3. The weighting was based on an iterative series of ratio adjustments, or raking. The population totals were based on phone ownership, race/ethnicity, education, race/ethnicity by age, gender by race/ethnicity, and age by gender. Tables 5 – 10 show population totals by raking margin.

Table 5: Phone Ownership Population Totals for Weighting

Phone Ownership	Pop	Percent
Cell Only	114,039	38.10%
Dual	161,330	53.90%
Landline Only/No Phone	23,945	8.00%

Table 6: Race/Ethnicity Population Totals for Weighting

Race/Ethnicity	Pop	Percent
White	113,726	38.00%
Black	146,486	48.94%
Hispanic	27,775	9.28%
Other	11,327	3.78%

Table 7: Education Population Totals for Weighting

Education	Pop	Percent
Less than High School Grad	65,875	22.01%
High School Graduate or GED	96,905	32.38%
Some college, 2-year degree	90,743	30.32%
4-year degree or more	45,791	15.30%

Table 8: Race/Ethnicity by Age Population Totals for Weighting

Race/Ethnicity	Age	Pop	Percent
White	18-34	36,495	12.19%
White	35-54	38,179	12.76%
White	55+	39,052	13.05%
Black	18-34	50,315	16.81%
Black	35-54	46,132	15.41%
Black	55+	50,039	16.72%
Other	18-34	18,024	6.02%
Other	35-54	12,985	4.34%
Other	55+	8,093	2.70%

Table 9: Gender by Race/Ethnicity Population Totals for Weighting

Gender	Race/Ethnicity	Pop	Percent
18-34	White	57,885	19.34%
18-34	Black	65,784	21.98%
18-34	Other	18,034	6.03%
35-54	White	55,841	18.66%
35-54	Black	80,702	26.96%
35-54	Other	21,068	7.04%

Table 10: Gender by Age Population Totals for Weighting

Gender	Age	Pop	Percent
Male	18-24	23,539	7.86%
Male	25-34	27,899	9.32%
Male	35-44	19,828	6.62%
Male	45-54	27,213	9.09%
Male	55-64	24,505	8.19%
Male	65-74	10,879	3.63%
Male	75+	7,840	2.62%
Female	18-24	23,799	7.95%
Female	25-34	29,597	9.89%
Female	35-44	23,096	7.72%
Female	45-54	27,159	9.07%
Female	55-64	24,419	8.16%
Female	65-74	15,491	5.18%
Female	75+	14,050	4.69%