Cellular Telephones in List-Assisted, Random Digit Dial Sample

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Abstract

Cell phone use has consistently risen over recent years; "cord-cutters" may be the biggest threat to random digit dial (RDD) surveys since they represent potential respondents who are intentionally avoided during the interview process. In the 2005 Behavioral Risk Factor Surveillance System (BRFSS) survey, cell phone numbers – including those ported from a landline – were flagged by the RDD sample vendor and excluded from calling. A question was also inserted into the survey's introduction that asked if the number reached was a cell phone. If so, the number was immediately removed from further calling.

Data from the 2005 BRFSS for multiple states were analyzed. Cell phone numbers were defined as either being flagged in the monthly sample files or the respondent answering affirmatively to reaching a cell phone in the survey's introduction. Numbers that were self-reported to be a cell phone were checked against a cumulative database of known cell phones in an effort to validate this response.

This paper describes the prevalence of cell phone numbers that were identified prior to and during the fielding period. Furthermore, trends by state or over time were examined.

Keywords: cell phone, cord-cutter, telephone data collection, RDD sample

1. Introduction

Since 2000, cell phone usage has increased dramatically while landline (wired, fixed) telephone service has steadily declined. As of December 2005, there were over 207 million cell phone subscribers in the United States (CTIA, 2006). With a current population of just over 298 million, that translates to one cell phone for every 1.4 people. On a household level, over 70 percent of all U.S. households have at least one cell phone (Piekarski, 2005). Of greatest concern are the "cord-cutters" — households that have abandoned landlines altogether and strictly rely on cellular phones. This proportion of the general population remains low, but is slowly growing. Recent estimates show that 6.7 percent of households are cell-only (Blumberg, Luke, Cynamon, 2006, 926-931). However, other research indicates that the prevalence of cell-only households may be as high as 10% (Piekarski, 2006).

The increasing reliance on cell phones poses a threat to population-based research that is conducted by telephone. Researchers are reluctant to interview respondents who are using a cell phone for many reasons, including the cost that is assumed by the respondent, respondent safety, and rules from the Telephone Consumer Protection Act of 1991—legislation aimed at preventing unwanted telephone calls. To avoid interviewing respondents on a cell phone, sample frames typically exclude telephone exchanges that are assigned for cell phone use only.

Compounding the sample screening process is the portability of local numbers. Local portability first allowed consumers to move (port) their landline phone number within local areas. Such portability challenges the telephone researcher's ability to precisely target sample. However, a more daunting situation appeared with the portability to and from wireless service. Launched in 2003, consumers could port phone numbers from a landline to wireless, wireless to wireless, and wireless to landline.

Sample providers have recently caught up with these portable numbers. They can identify ported numbers with the assistance of a national database that tracks when a number ports as well as its new status (i.e., landline, cellular). Numbers that have ported, and are currently assigned to cellular phones, can be identified in this database and subsequently removed from the sample frame—along with those from known cell phone exchanges.

Sample screening is one approach to reducing unwanted calls to cell phones. Another method is to screen the number during the introduction to the interview. For example, this involves simply asking the contacted individual if he or she has been reached on a cell phone. While the original intent behind such identification might be to remove these numbers as ineligible, there is current debate over whether it is acceptable to pursue interviewing a cell phone respondent if he/she consents to the process.

2. Background

An example of a telephone survey that both screens for cell phones through sample and survey design is the national Behavioral Risk Factor Surveillance System (BRFSS), coordinated by the Centers for Disease Control and Prevention (CDC) and state health departments. The system is made up of state-based surveys that collect data on health-related behaviors and conditions. Data are collected in monthly time periods and later aggregated for analysis on a yearly basis. Non-institutionalized adults (age 18 years and older) are randomly selected to participate from each contacted household.

The BRFSS uses random digit-dialed (RDD) samples from one-plus banks of phone numbers in each state. One-plus banks have at least one listed household phone number in them. This method allows households with telephones to have a known, non-zero probability of being sampled. Disproportionate stratified sampling (DSS) is also applied where listed residential telephone numbers are sampled at a higher rate than unlisted telephone numbers. DSS further increases the chances of reaching an eligible household—by oversampling listed residences. Several states conduct statewide sampling. Others stratify their sample to collect data that is sufficient to meet local research objectives. Most stratify by geographic area (e.g., counties, cities); however, sub-populations are targeted using other definitions (e.g., race/ethnicity, health districts).

Several changes have been made to BRFSS in recent years to prevent calling cell phones. A distinct cell phone disposition code was added in 2004. If an interviewer assigned this code, the phone number was automatically removed from further calling. Interviewers knew to assign the cell phone disposition only upon the respondent's self-disclosure. In 2005, to take the responsibility off of the respondent, a question was added to the survey's introduction—asking if the respondent had been reached on a cell telephone. Assuming households stay on the phone long enough to get to this cell phone question, it leaves little doubt about whether a cell phone was inadvertently contacted. The other major change to the BRFSS deals with sample screening. Sample is routinely screened and numbers that are nonproductive, including non-working, business, and (most recently) cell phone numbers, are flagged. Flagged numbers remain in the sample file, but they are excluded from calling. This process was appended to the existing method of excluding known cell phone exchanges from the sample frame.

3. Objective

The BRFSS allows us to observe numbers that are screened out in the sampling process as well as the residents who self-report cell phone status. The purpose of this research is to identify how many cell phones occur in BRFSS RDD sample both prior to and during the fielding period. Furthermore, we hope to determine whether there are notable trends by state or over time.

4. Methods

In 2005, ORC Macro conducted BRFSS surveys on behalf of 10 states and the District of Columbia. Data was collected using Computer-Assisted Telephone Interviewing (CATI) from January through December. Although interviewing occurred on a monthly basis, data was aggregated into one, annual file for this analysis. Un-weighted sample and survey introduction data were used. The data was not weighted because we are reporting primarily sample characteristics, not estimates from the survey. Most of the sample records do not have sufficient information to perform traditional weighting techniques (e.g., age, sex). SAS® was used to produce descriptive statistics on cell phones in the RDD sample, as presented in the *Results* section of this document.

In order to measure cell phones in the sample, a cell phone definition was constructed and applied to all sampled phone numbers. There are a variety of ways in which a phone number results in a cell phone outcome. For this study, a cell phone was defined if any of the following conditions were met:

- The phone number was flagged in the monthly sample files as a cell phone,
- The respondent answered affirmatively to the question about reaching him/her on a cell phone in the survey's introduction, or
- A cell phone disposition was assigned to the phone number.

In addition to simply measuring the number of cell phones in the sample, we were interested in trying to validate cases where the resident reported that they were reached on a cell phone. The question followed a general project introduction and confirmation that the correct number was dialed. It read: "Is this a cellular telephone?" If the resident replied "Yes", the interviewer said "Thank you very much, but we are only interviewing landline telephones and private residences." We hypothesized that residents who said that they were contacted on a cell phone had recently

ported because the sample frame excludes known cell phones. Numbers that were self-reported to be a cell phone were checked against a cumulative database of ported cell phones. The database of ported numbers is maintained by Neustar, Inc. and tracks all instances of numbers that move from one account to another. We reviewed the BRFSS sample records that appeared in the Neustar database from 2004 through February 15, 2006.

5. Results

Our results are presented below, in the following categories: *Prevalence*, *Temporal Trends*, and *Method of Identification*. *Prevalence* gives an overview of the degree to which cell phones occur in the 2005 BRFSS sample, while *Temporal Trends* examines the number of cells phones in monthly samples. *Method of Identification* reveals how cell phones were identified in the sample; this section also takes a closer look at those who said "yes" to the cellular telephone question in the survey introduction.

When reviewing these findings, please remember that exchanges that are known to be cell phones are excluded from the sample frame. If they were included in the sample frame, there would be many more cell phone outcomes. Our results expose only those cell phone numbers identified during the screening process or at the beginning of the BRFSS interview.

5.1 Prevalence

Across 11 states, a total of 720,750 phone numbers were sampled from January through December 2005. Of these, 4,645 could be identified as cell phone, which represents less than one percent (.64%) of the RDD sample. The prevalence of cell phones varied slightly by state, with the highest percent occurring in Connecticut (.85%) and the lowest in New Hampshire (.37%).

The prevalence of cell phones also varied within states by strata. The lowest percentage was observed in Cheshire County, New Hampshire (.11%) and the highest percentage in micropolitan statistical areas and non-metro counties in Texas (1.12%). Because states stratify their sample in different ways, it is difficult to directly compare cell phone penetration. Generally speaking, areas with lower cell phone prevalence were rural while the highest percent of cell phones was observed in urban and Hispanic populations.

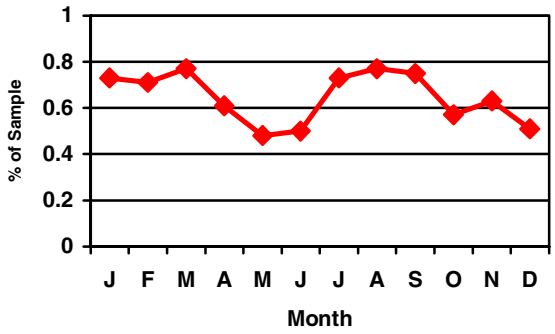
Table 1. Percentage of Cell Phones by State and Strata

State (Strata)	%
Arizona	**0.7**
Maricopa County	0.73
Pima County	0.61
Apache, Coconino, Navajo Counties	0.63
Gila, La Paz, Mohave, Yavapai Counties	0.63
Graham, Greenlee, Pinal Counties	0.6
Cochise County	0.87
Santa Cruz County	0.66
Yuma County	1
Connecticut	**0.85**
Urban	0.88
Rest of State	0.82
District of Columbia	**0.58**
Maine	**0.6**
Cumberland County	0.65
Penobscot, York Counties	0.76
Androscoggin, Aroostook, Kennebec Counties	0.72
Hancock, Oxford, Somerset Counties	0.44
Franklin, Knox, Lincoln, Piscataquis, Sagadahoc, Waldo, Washington Counties	0.43
Maryland	**0.61**
Urban	0.62
Rural	0.58
Allegany County	0.63
Garrett County	0.44
Washington County	0.79
Massachusetts	**0.76**
Norfolk, Suffolk Counties	0.7
Hampden County	0.54
Worcester County	1.04
Essex, Middlesex Counties	0.81
Bristol County	0.9
Rest of State	0.72
Montana	**0.45**
High Density Native American Counties	0.41
Medium Density Native American Counties	0.26
Low Density Native American Counties	0.62
Yellowstone County, Carbon County	0.8
New Hampshire	**0.37**
Belknap County	0.33
Carroll County	0.19
Chesire County	0.11
Coos County	0.51
Grafton County	0.41
Rest of Hillsborough County	0.28
Merrimack County	0.54
Rockingham County	0.33
Strafford County	0.34
Sullivan County	0.91
Manchester	0.35
Nashua	0.33
New Jersey	**0.63**
Atlantic County	0.5
Cape May County	0.33
Cumberland, Salem Counties	0.66
Gloucester County	0.78
Hunterdon County	0.51
Mercer County	0.69
Somerset County	0.49
Sussex County	0.64
Warren County	0.64
Rest of State	0.63
Newark	0.64
Jersey City	0.82
Paterson	0.79
Rhode Island	**0.75**
Central Providence	0.7
Outer Providence County	0.88
Kent County	0.82
Bristol, Newport Counties	0.64
Washington County	0.59
Texas	**0.74**
Houston-Baytown-Sugar Land MSA	0.66
Dallas-Plano-Irving PMSA	0.82
Fort Worth-Arlington PMSA	0.68
San Antonio MSA	0.63
Austin-Round Rock MSA	0.63
El Paso MSA	0.49
Remaining Metro Counties	0.65
Micropolitan Statistical Areas and Noncore Counties	1.12

5.2 Temporal Trends

Next, we looked to see if there was any sort of temporal pattern to finding cell phones in the sample—specifically if the trend was increasing along with the growing number of cell phone subscribers. The trend is bimodal. Cell phones were detected more often in sample from Quarters 1 (January-March) and 3 (July-September) in 2005. Due to the bimodal pattern, a linear trend is not statistically significant (p=.3).

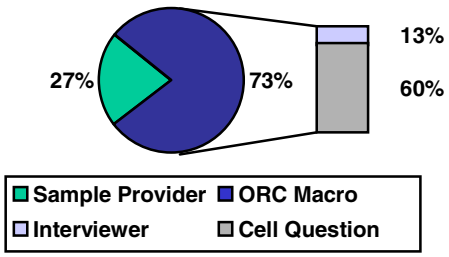
Figure 1. Cell Phones in Monthly RDD Sample



5.3 Method of Identification

We hypothesized that most of the cell phone numbers would be identified through the sample screening process—that is, very few (if any) would be called by a BRFSS interviewer. The results show quite the opposite. Sample screening picked up 27 percent of the cell phones but most (73%) were identified in the field by a BRFSS interviewer.

Figure 2. Method of Cell Phone Identification
(N=4,645 Cell Phones)



Cell phones were identified by BRFSS interviewers in two ways: 1) asking the question about whether they reached a cell phone, or 2) by assigning the cell phone disposition for those who did not make it to that question. Of the 3,390 cell phones that were identified by a BRFSS interviewer, 18 percent terminated the call(s) before reaching that question. But the majority (82%) stayed on the phone long enough to answer "yes" to the question about reaching them on a cell phone. The question typically occurs within the first minute of the survey.

Our interest peaked around those who replied "yes" when interviewers asked if they reached the resident on a cell phone. These numbers were checked against all available sources, so how could they belong to cell phones? Perhaps they are people who recently ported their landline to cell phone. In other words, they moved their phone number to a cell line in the time between preparing the sample and going into the field. So, we investigated the porting behavior of these records by searching for them in the Neustar database—a national repository that tracks phone numbers that port (in any direction) and when the activity occurs. We searched for porting that occurred prior to 2005 through February 2006. Extremely few (less than one percent) actually ported the number we called to a cell phone, either before or after our call. Nearly all of the cases had no record of porting a number to cell phone around the interviewing month, either in the past or near future.

6. Conclusions

Despite rigorous sample screening, cell phones will inevitably be contacted when using RDD sample—perhaps more so when sample is list-assisted because residential phone numbers are oversampled. After excluding known cell phone exchanges from sample frames, less than one percent of list-assisted, RDD sample numbers are cell phones. This figure may underestimate the actual number of cell phones because people may screen their calls and will not answer if they do not expect the call or do not recognize the caller.

While one percent of the total sample seems small, if researchers discard these numbers as ineligible, there are cost and response rate implications. Additional sample is required to make up for the increased number of contacts that are removed as ineligible. Interviewers will, in turn, use more time to call the additional phone numbers. As far as response rates are concerned, any increase in the ineligible category will negatively influence the response rate calculation, resulting in a lower response rate.

Contacting cell phones varies by state and even within states. Cell phones were detected more often in urban and ethnic areas. This pattern is similar to national trends of cell phone subscribers, where central city areas have a higher prevalence of cell phones than non-central city and rural areas (Tucker, Brick, Meekins, Morganstein, 2004). Other research has also shown that Hispanics are less likely to have landlines and more likely to be wireless-only households (Blumberg, Luke, Cynamon, 2006, 1-6). These geographic patterns of usage are substantial considerations in RDD surveys—particularly when urban and ethnic groups are the populations of interest.

The most striking finding of this observational study is the frequency with which residents say that we have contacted them on a cell phone—yet there is no indication that the number belongs to a cell phone. There may be several explanations for this finding. First, it may indeed be a cell phone, but slips through the sample screening process because the number assignment has not been reported by the cellular service provider. If the service provider does not report—or is slow to report—the number as belonging to a cell phone, it would be unlikely to be screened out of the sample. Second, the resident may misunderstand or misreport (intentionally or unintentionally) the question about reaching a cellular telephone. The third and most likely scenario is that the number dialed may have connected to a cell phone but is, in fact, assigned to a landline. This situation might occur if the household forwards their landline calls to a cell phone. Approximately 1.8 million Americans forward their landline to a cell phone on any given day (Kulp, 2005). So, it is very likely that most records with a cell phone disposition are a result of call forwarding.

The concept of call forwarding adds another dimension for the telephone researcher to consider and conquer. To date, interviewing respondents on a cell phone has been an unsavory option. However, if the household is forwarding all calls that would normally be received on a landline, shouldn't they expect that some would be unsolicited—such as those for research purposes? Understandably, some residents will resist any attempt to be interviewed, especially on a cell phone. However, some may continue, as evidenced by their willingness to stay on the phone long enough to be asked whether they were reached on a cell phone. While that question typically occurs within the first critical, free minute of cell phone use, it does occur after a somewhat detailed introduction and explanation of the project. Rather than terminating the call after that early cell phone question, maybe it would be wise to ask the respondent if he or she has time to continue or if a call-back appointment should be scheduled. Another item to consider when calling cell phones is to confirm the place of residence since telephone consumers can choose a phone number from virtually anywhere across the country. It is no longer sufficient to assume that a phone number belongs to a particular area. Re-wording survey introductions to accommodate and capture the call-forwarder seems to make sense given this county's growing dependence on cellular telephones.

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The authors of this paper are solely responsible for its content and conclusions do not necessarily represent the opinions of ORC Macro, state health departments, or CDC.

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