

# Using the National Provider Identifier File as the Sampling Frame for a Physician Survey

Jay Clark and Ralph DiGaetano  
Westat, 1600 Research Blvd., Rockville, MD 20850

## Abstract

For many years the American Medical Association (AMA) Masterfile has served as the standard sampling frame for physician surveys. Its primary advantages are high coverage and some useful auxiliary variables for sampling and estimation. However, the contact information provided is often out-of-date, and some physicians have no contact data provided, adding to survey nonresponse. An alternative sampling frame was used to conduct a recent survey of physicians in the specialties of Family Medicine and Internal Medicine. The frame was derived from the National Provider Identifier (NPI) file of individual health care providers maintained by the Centers for Medicare and Medicaid Beneficiaries (CMS) as part of the National Plan and Provider Enumeration System (NPES). The results are promising in terms of coverage provided, and the contact information was more up-to-date than previously experienced with the AMA file. However, there were some drawbacks as well. This paper discusses these findings and draws comparisons to surveys where the AMA file was used as the sampling frame. Some strategies for enhancing the usefulness of the NPI file are also considered.

**Key Words:** sampling frame, coverage, physicians, sample design, estimation

## 1. Introduction

As the structure of health care in the United States continues to evolve, researchers have shown great interest in learning about physicians' perspectives on how changes to the health care system affect their activities associated with patient care, meeting the requirements of the system, taking advantage of new technologies, etc. Sample surveys of physicians provide an important vehicle for obtaining such information. A major component of developing a sampling design for such surveys is to ensure that the information is as accurate and reliable as possible.

The American Medical Association (AMA) Masterfile of physicians has been commonly used as the sampling frame for physicians. However, a new file, often referred to as the "NPI" file, has the potential to provide an alternative frame for physician surveys. Westat has recently used it for that purpose for the Oral Health Survey (OHS).

This paper reports on the experience of using this file as the sampling frame and its potential for use in future surveys, comparing its performance to the use of the AMA file as the frame for other surveys. Section 2 covers the standards for evaluating a file for use as a sampling frame for physicians. Sections 3 and 4 discuss the AMA and NPI files in more detail. The OHS is described in section 5. Section 6 provides an evaluation of the

NPI file as a sampling frame relative to that of the AMA. Finally, section 7 provides implications of the findings for future studies.

## **2. Standards for Evaluating Physician Sampling Frames**

While there is good reason to believe that the AMA file provides high coverage of medical doctors (as well as including many doctors of osteopathy or DOs), there are some problems with its use as a sampling frame of physicians. As a result, many researchers have been exploring alternative sources for such frames.

The file of individual health care providers with National Provider Identifiers (NPIs) maintained by the Centers for Medicare and Medicaid Beneficiaries (CMS) as part of the National Plan and Provider Enumeration System (NPPES), known as the NPI file, is one alternative. CMS also maintains a separate file of health care organizations with NPIs, but that is not discussed here other than to note that there is no link between the two NPI based files.

There are a number of factors to be considered in evaluating the suitability of the AMA and NPI files to serve as a source for a sampling frame for physicians. They include:

- Coverage of the target population
- Accuracy of contact information
- Availability of auxiliary data
- Extent of duplicates
- Extent of ineligible records
- Cost
- Misclassification issues

These factors are addressed in some detail in DiGaetano (2013). We will touch on the most important aspects here.

### **2.1 Coverage**

Failure to include all the physicians in the target population on the sampling frame introduces the risk of noncoverage bias. Some files may provide high coverage of some types of physicians (e.g., particular specialties or office-based physicians) but not others. Coverage is generally the most important factor when considering the suitability of a file to serve as a sampling frame.

### **2.2 Contact Information**

Inaccurate contact information results in tracing costs and delays in the data collection due to the need to find the sampled physicians. Failure to locate a sampled physician results in survey nonresponse.

### **2.3 Available Auxiliary Information**

In addition to basic information needed for sampling physicians (e.g., name, address and/or phone number, and specialty), additional variables can be useful for stratification and/or weighting purposes. These could include work setting (office-based, hospital, etc.), age, gender, race/ethnicity, and others.

## 2.4 Duplicate Records

When working with a list sampling frame, it is good practice to try to eliminate all duplicate records on the frame prior to sample selection. Duplicates not identified lead to multiple chances of selection for some physicians. If later identified, weights can be modified to reflect the increased chance of selection, but this adds to the sample variance. If not identified, the potential for bias arises, as weights designed to reflect each physician's chance for selection will be inaccurate for those physicians with unknown multiple chances of selection.

## 2.5 Ineligible Records

Not all records on a sampling frame of physicians represent physicians who are members of the target population for a given study. For example, a study that focuses on physicians currently seeing patients in an office-based setting would consider those who are solely administrators, teachers, or who work only in hospitals as ineligible (although they may be eligible for another study with a different focus). Retirement, death, change of jobs, or misclassification (e.g., of specialty) are other possible reasons for ineligibility. Sample screening is required to identify ineligibles, adding to survey costs. To the extent that auxiliary data are accurate and can be used for screening purposes, such costs can be limited.

## 2.6 Cost

There are many potential costs associated with the file used for establishing a sampling frame. There is the direct cost of purchasing the file. There are also costs associated with supplementing the frame with data from another file, if such supplementation is considered desirable, as well as the procedures needed to trace sampled physicians when contact information is inaccurate or missing. Because costs are survey dependent, no attempt is made to quantify costs for this paper, but factors contributing to costs are noted.

## 2.7 Misclassification

Misclassification issues arise when frame variables used for stratification or eligibility purposes are inaccurate. Depending on the target population and the sample design, such inaccuracy can lead to variance and/or bias concerns. For example, suppose a study is focused on primary care physicians in the specialties of Family Medicine (FM) or Internal Medicine (IM) who see patients in an office-based setting. Also suppose for this study the frame consists of only those physicians in the two specialties (based on the file data), and the two specialties are sampled at different sampling rates. To the extent that physicians sampled as IM turn out to be FM or vice versa, sample variance is increased but bias is not incurred. However, if some physicians classified as General Practitioners (GPs) are actually FMs, then the potential for bias is incurred since they had no chance of selection for the study (an undercoverage issue). Bias would arise for estimated totals, but might be less of an issue for estimated means or proportions, depending on the extent to which physicians who are not covered by a frame differ from those who are found on the frame with respect to the items of analytic interest to a study.

Similarly, if the sampling frame is subset to comprise only FMs and IMs flagged as office-based, but the flag is inaccurate and some physicians are dropped from the frame despite working in an office-based setting, then bias may result. One approach to handling this situation is to sample among all FMs and IMs on the file but sample those not flagged as office-based at a lower rate. If the office-based flag is generally accurate,

this can help reduce screening costs, but it will add to the variance due to the use of differential sampling rates.

### **3. The AMA File**

The AMA Masterfile has a number of positive features for sampling physicians for a survey. First of all is the expectation of high coverage of physicians due to the way records of physicians are obtained. The records are first established among students entering medical schools in the U.S., and they are supplemented with records for physicians from foreign countries practicing in the U.S. In addition, the AMA Masterfile has a number of auxiliary variables for sampling and weighting purposes such as date of birth, type of practice (office-based, hospital, etc.), sex, race/ethnicity, and others, although there may be missing data on some of these items.

On the negative side is the accuracy of the data provided for some data items. Of particular concern is the contact information, which can be out-of-date or, for a small percentage, not even provided, as discussed below.

As an illustration, consider a survey sponsored by the National Cancer Institute (NCI) of primary care physicians with adult patients (in addition to FMs, IMs, and GPs, OB/GYNs were also included) carried out in 2006 where the sampling frame was established from among the physicians flagged as office-based on the AMA file. The title of the study was the “National Survey of Primary Care Physicians’ Recommendations and Practices for Breast, Cervical, Colorectal, and Lung Cancer Screening (see Klabunde, Lanier, Nadel, et al. (2009)), but it was often referred to as the Cancer Screening Study (CSS) and that is the name we will use here. Klabunde, Willis, McLeod, et al. (2012) report that tracing was required for about 20 percent of the sampled physicians to obtain up-to-date contact information (telephone numbers and/or office addresses) and, ultimately, despite these tracing efforts about 7 percent of the sampled physicians could not be located. The need for tracing adds to survey costs and the inability to locate sampled physicians raises concerns about potential bias due to survey nonresponse. Klabunde, et al. (2012) also reported other data quality issues with the AMA file: about 7 percent of the respondents were not currently practicing medicine; and roughly 6 percent were in a specialty other than the one indicated on the AMA file. Finally, they noted that across the four specialties included in the CSS, about 4 percent of sampled physicians declined to allow AMA file contact information to be provided. This “no contact” contribution to survey nonresponse varies by specialty, as is illustrated later. Thus, there can be built-in survey nonresponse associated with the use of the AMA file.

### **4. The NPI File**

The NPI file of individual providers that is part of the NPPES maintained by CMS contains physicians as well as other types of individual health care providers, including nurse practitioners, registered nurses, pharmacists, and dentists. Another “NPI” file contains records representing health care organizations that have NPIs. Some background information is provided about these files here, to indicate why high coverage of target populations of physicians in many specialties could be expected as well as why contact information can be expected to be relatively up-to-date, at least currently. DiGaetano (2013) provides substantially more detail on these matters.

NPIs are unique identification numbers assigned as part of the NPPES and are required of all “HIPAA covered entities” (HIPAA stands for the Health Insurance Portability and Accountability Act). A HIPAA covered entity is one that conducts HIPAA standard transactions such as claims and eligibility inquiries. Since the organization for which physicians work generally undertakes such transactions, this requirement does not pertain to most physicians. However, with the passing of the Affordable Care Act (ACA), all physicians who see Medicare or Medicaid patients are required to obtain an NPI. Moreover, all other physicians are encouraged to obtain an NPI.

Comparisons of counts of physicians by specialty between the NPI individual provider file and the AMA physician Masterfile (some of which appear shortly) suggest that the NPI coverage of physicians may be on a par with that provided by the AMA file for many specialties. In addition, since the NPI contact information was obtained relatively recently, it is likely to be relatively up-to-date. Although physicians who change their place of employment are requested to update their NPI contact information, no formal effort is made to help ensure that such updates are made.

There is little auxiliary information available on the NPI file that can be used for sampling or weighting purposes. ZIP code could be used from the office address as a geographic variable, and the address could be geocoded to provide the county where the office is located. However, information from a vendor could be used to supplement the auxiliary data.

The NPI files for both individual and organizational health care providers can be downloaded free of charge from the CMS website, and many vendors have developed files of health care providers based on NPI records. Many of these vendors regularly update the contact information as well as adding potentially useful auxiliary data for sampling and weighting purposes. They are willing to provide, for a fee, requested auxiliary data for a set of NPI records provided to them. Thus, a potentially promising approach would be to select a sample of physicians from the NPI individual provider file and then supplement the contact and other information from the NPI file with updates from a vendor. Research is needed to determine what potential vendors could provide to improve the sample information, and the choice between vendors may depend on the focus of the study (e.g., the particular specialties of interest) as well as factors such as cost and evidence of up-to-date information.

Another potential source of data for supplementing the NPI individual provider file is the Physician Compare file, also maintained by CMS and available free of charge from the CMS website. The Physician Compare file is a physician level file with NPI as an identifier variable, so the records can be routinely linked to the NPI file. The Physician Compare file includes year of graduation, which can serve as a proxy for age. Issues with the Physician Compare file may be the extent to which data items have missing data as well as a failure to include all physicians on this file.

The extent of duplication of individual providers on the NPI file can be expected to be minimal (e.g., physicians who mistakenly believe they need multiple NPIs if they have multiple specialties) because there would appear to be no benefit to an individual that acquires multiple NPIs. The extent of ineligible records (e.g., due to deaths or retirement) and misclassification for the NPI was unknown prior to undertaking the Oral Health Survey, and what was ultimately learned only directly applied to the specialties from which the sample was drawn. The NPI file does not have a flag to characterize an

individual as office-based, so the frame could not easily be limited to office-based physicians, meaning high coverage would be ensured, but extensive screening could be required. Upon completion of the Oral Health survey, misclassification between the two specialties of interest was assessed (it was limited), but such an assessment does not necessarily generalize to the full set of medical specialties.

## 5. The Oral Health Survey

### 5.1 Purpose

The Oral Health Survey (OHS) was developed to collect data on the knowledge, attitudes, and experience of oral health issues for the two largest specialties serving as primary care physicians (PCPs), namely family medicine (FM) and internal medicine (IM). The study explored physicians' oral health training and competencies, knowledge of guidelines, attitudes and views of their role in oral health, and current practices and barriers to further involvement. The intention of the study was to develop baseline levels for future comparisons.

Eligible physicians for the OHS had to be in the FM or IM specialties, spend at least 20% of work time treating patients, and provide primary care somewhere other than in an urgent care center, rehabilitation center, nursing home, correctional facility, or Federal facility.

### 5.2 Sample Design

The sample design for the OHS was a two-phase list sample from a frame consisting of PCPs in the U.S. These physicians were identified on the NPI individual provider file, and a systematic random sample was selected from the frame after sorting by specialty, Census region, and ZIP code.

The NPI file was considered to be a promising source for the sampling frame for the OHS because the numbers of IM and FM records were similar to the counts of IM and FM records on the AMA Masterfile, and thus the coverage was expected to be similar. Table 1 provides the number of physicians found on the AMA and NPI files in October 2012, roughly six months prior to the OHS going into the field.

**Table 1:** Total Number of Physicians on File, October 2012

<i>Physician Specialty</i>	<i>AMA</i>	<i>NPI</i>	<i>NPI/AMA</i>
Family Practice/medicine (FM)	100,801	109,554	1.09
Internal Medicine (IM)	121,095	119,040	0.98
General Practice (GP)	8,986	9,704	1.08
Pediatrics (PED)	61,183	54,886	0.90
General Surgery (GS)	31,333	27,534	0.88
Obstetrics and Gynecology (OB/GYN)	41,308	33,947	0.82

There was uncertainty about the ineligibility rates that might be experienced when using the NPI file as a frame source, since the sampling frame would not be limited to physicians flagged as office-based, which would remove many ineligible physicians from the frame. Many previous Westat surveys that used the AMA file limited the sampling frame to those flagged as office based and were expected to have relatively low ineligibility rates. Another consideration was that the NPI file was established more

recently, so contact information for the physicians was considered more likely to be current. Also, the NPI file could be obtained at no cost, increasing its appeal as an alternative to the AMA file as a frame source.

Sampled physicians for the OHS were initially screened by telephone, and questions were constructed to be addressed to those likely to answer the phone in physicians' workplaces. The questions on this initial screener were used to verify contact information and to exclude many of the physicians who were ineligible for the OHS target population. If the contact information could not be verified, a tracing effort was undertaken to try to locate the sampled physician.

After the initial screening effort, eligible sampled physicians and those who could not be contacted at the screener were mailed a questionnaire using the most current contact information available (either from the frame or updated after the tracing effort). The questionnaire included further screening questions asked directly of the sampled physician, including eligibility requirements that could not be collected at the initial telephone screening.

Because this sample design required both a telephone screener and a mailed questionnaire, having more accurate telephone numbers and addresses on the frame reduced the amount of time needed to screen and trace the sampled physicians.

## 6. Results

### 6.1 Surveys for Comparison

The response rates, eligibility rates, and coverage rates obtained for the OHS using the NPI file may be assessed by comparing the rates to the corresponding rates in several prior surveys that used the AMA Masterfile as the sampling frame. The following physician surveys were used for comparison:

- Cancer Screening Study (CSS)  
([http://appliedresearch.cancer.gov/screening\\_rp/](http://appliedresearch.cancer.gov/screening_rp/))
- Energy Balance (EB) ([http://appliedresearch.cancer.gov/energy\\_balance/](http://appliedresearch.cancer.gov/energy_balance/))
- Survey of Physician Attitudes Regarding the Care of Cancer Survivors (SPARCCS) (<http://appliedresearch.cancer.gov/sparccs/>)
- National Ambulatory Medical Care Survey (NAMCS)  
(<http://www.cdc.gov/nchs/ahcd.htm>)

The first three of these surveys were conducted by Westat – the CSS in 2006, the EB in 2008, and SPARCCS in 2009. These surveys were selected for comparison because they had similar sample designs and data collection approaches to the OHS.

The NAMCS is conducted annually by the National Center for Health Statistics (NCHS), and the data obtained for comparison is from 2010. The sampling frame and eligibility criteria for the NAMCS were similar to the other studies. However, there are many differences that should be noted.

The 2010 NAMCS sample design and data collection approach differed considerably from the other studies. For the 2010 NAMCS, an area probability sample of office-based physicians was drawn, and data were collected on randomly selected office-based visits

within a randomly selected week. The NAMCS also differed by offering no incentive for participation while all the Westat studies, including the OHS, offered an incentive of \$50. In addition, the NAMCS pooled General Practitioners (GPs) with FMs for both sampling and analysis purposes. While GPs are a much smaller specialty than FMs (and GP is a specialty that is gradually disappearing), it does add an element of uncertainty for comparison purposes here.

All four of these comparison surveys used physicians flagged as office-based on the AMA file as the source of the frame, and all included FM (called “Family Practice” on the AMA file) and IM specialties in the target population. (Other specialties were also included in these surveys but are not considered in this paper.)

## 6.2 Response Rates

Table 2 shows the response rates for the three Westat-based comparison surveys and the OHS by specialty. The NAMCS response rates are not included for comparison because of the differences in sampling design and data collection procedures.

**Table 2:** Response Rate Percentages

<i>Specialty</i>	<i>AMA/Office-Based</i>			<i>NPI (full)</i>
	<i>CSS</i>	<i>EB</i>	<i>SPARCCS</i>	<i>OHS</i>
FM	71.8	63.3	67.0	65.9
IM	67.1	63.1	65.5	64.0

Response rates for the OHS, using the full NPI frame, were similar to the Westat studies that used the AMA frame subset to the office-based physicians. The contact information on the NPI file proved to be more accurate than that in the other Westat studies, resulting in the need for less tracing for the OHS.

## 6.3 Office-Based Eligibility Rates

First, when the AMA file is subset to physicians who are office-based, the size of the sampling frame is reduced. In the four surveys using the AMA file as a sampling frame, the frame of office-based physicians was obtained by eliminating physicians without the office-based flag. This step reduced the file for FMs by about 21.5% and that for IMs by about 34.6%. This represents a considerable reduction in sampling frame size and would be expected to affect eligibility rates to the extent that the office-based flag was accurate. This frame reduction was not possible with the NPI frame.

The eligibility rates for the four comparison surveys were all for those sampled physicians flagged as seeing patients in an office-based setting (an eligibility requirement for all five surveys). Table 3 shows the eligibility rates for the four comparison surveys and the OHS, by specialty.

**Table 3:** Eligibility Rate Percentages

<i>Specialty</i>	<i>AMA/Office-Based</i>				<i>NPI (full)</i>
	<i>CSS</i>	<i>EB</i>	<i>SPARCCS</i>	<i>NAMCS</i>	<i>OHS</i>
FM	82.7	77.5	79.7	63.2	61.6
IM	67.9	61.2	65.8	62.8	39.3



For FMs the eligibility rate for the OHS was much lower than the comparison surveys for Westat (the three of which had similar rates) but about on a par with the NAMCS estimate. For IMs the OHS eligibility rate was markedly lower than all four comparison surveys, and all four comparison surveys had similar rates.

Since the four comparison surveys using the AMA file as a frame source restricted the sample to physician records flagged as office-based, many ineligible records were not included in the sample and thus those surveys would be expected to have higher eligibility rates than the OHS, which included all physicians. This was generally the case. The exception was the eligibility rate for the FMs in NAMCS, but it is unclear why that rate was relatively low. GPs were included in the same strata and analytic domain as FMs and could be expected to have somewhat lower eligibility rates than FMs as they tend to be older and thus more likely to have retired. However, GPs were a small proportion of the NAMCS sample, and it would not be expected to have such a large impact. It is unclear why the eligibility rate for FMs in the NAMCS appears to be relatively low. The eligibility rate for the IM specialty is particularly low for the OHS, suggesting that the AMA file flag to identify office-based physicians can be effective in removing ineligible cases.

The screening out of ineligibles helps limit survey costs. We next consider what price might be paid in terms of sample coverage, to the extent that physicians not flagged as office based on the AMA file were actually office-based.

#### 6.4 Estimated Number of Physicians

Table 4 shows the estimated number of office-based physicians for the four comparison surveys and the OHS, by specialty. Estimated standard errors (SEs), which are often used to provide a measure of the precision of the estimates, were not available on the estimated number of survey eligible physicians for these surveys. Approximate SEs were computed based on reported or estimated design effects and were used to help assess if any differences may have reached the level of statistical significance.

**Table 4:** Weighted Estimates of Number of Physicians (Assessing Coverage)

<i>Specialty</i>	<i>AMA/Office-Based</i>				<i>NPI (full)</i>
	<i>CSS</i>	<i>EB</i>	<i>SPARCCS</i>	<i>NAMCS</i>	<i>OHS</i>
FM	61,308	58,654	60,790	57,803	69,288
IM	54,403	48,939	52,395	44,882	48,621

The estimated number of FM specialty physicians from the OHS survey was on the order of 10,000 physicians larger than the estimates from the other surveys, and this difference was significant at the 0.05 level. This suggests that using the full NPI file as a sampling frame provides better coverage of FM physicians than the AMA file restricted to those flagged as office-based. Thus, while effective at screening out ineligible FMs and assuming that the AMA file's overall coverage of FMs is at the same level as the NPI file, use of the AMA office-based flag for this specialty to exclude physicians from the sampling frame appears to result in substantial undercoverage of FMs seeing patients in an office-based setting.

The estimated number of IM specialty physicians from the OHS survey was not significantly different from the estimates from the other surveys, suggesting that the office-based flag on the AMA Masterfile is more accurate for the IM specialty and a big

penalty may not be paid by using the flag to limit the IMs to be sampled in a study of IMs currently seeing patients in an office-based setting.

There are uncertainties associated with these evaluations. For example, differences in the way eligibility was determined (i.e., screening questions asked and of whom) as well as survey mode could have contributed to differences in estimates, even though the eligibility requirements were similar.

Review of sampling frame sizes indicated that Westat frame sizes were quite similar with slightly fewer physicians found on the NAMCS frame. The frame sizes of FMs for the Westat studies ranged from 74,000 to 76,000 while the NAMCS size was 74,800. For IMs the Westat frames were all about 80,000 whereas for the NAMCS it was 76,700. Since the NAMCS frame for FMs also included GPs, the NAMCS estimate for FMs alone would have been somewhat smaller.

### **6.5 Operational Comparisons**

In addition to a review of the results obtained from using the AMA and NPI frames, some comparisons of the data on the Westat frames were made. The latest Westat study prior to OHS, the SPARCCS study, had missing telephone numbers for about 25-30% of the sample, and these missing data required a larger tracing effort.

About 4-5% of the FMs and IMs sampled for the CSS and EB were flagged as “do not contact” (no similar data were available for the more recent SPARCCS). These physicians were eligible for each of the surveys, but they had no name or contact information provided on the AMA file. Such physicians are screener nonrespondents since no attempt to contact them could be made to establish survey eligibility status.

In contrast, the OHS, using the NPI file, had full contact information, including names, addresses, and telephone numbers, for all of the physicians on the frame. This reduced the amount of tracing needed. Of course, not all of the contact information was accurate, but none of it was missing, so tracing was possible.

## **7. Implications for Future Studies**

The results of the OHS indicate that the NPI file is a viable alternative to the AMA Masterfile as a frame source, at least for the FM and IM specialties. The expected coverage of the target population that can be obtained from the NPI file should be investigated before using it as a sampling frame for other specialties.

Consideration should also be given to supplementing the NPI file with auxiliary variables from files provided by vendors. These supplemental files can be linked to the NPI file by the NPI identification number. Depending on the survey requirements, adding auxiliary variables could help increase the precision of sample estimates by providing more information for stratification purposes. Doing so could also help reduce the potential for bias by providing more information for nonresponse adjustments to the sample weights.

Although efforts are made to keep the contact information current, the NPI file may become increasingly out of date as it ages. Updated contact information provided in supplemental files provided by vendors may help limit both operational costs associated with tracing and survey nonresponse due to the inability to locate sample physicians.

The surveys selected for comparison in this paper all used the AMA Masterfile as a sampling frame, but limited it to the records flagged as office-based. A more direct comparison between the AMA file and the NPI individual file would be to carry out a survey that sampled FMs and IMs from the full AMA file. Separate strata for physicians classified on the frame as office-based and non-office-based could be established. Using the full AMA file as the frame would increase coverage, especially among the FM physicians, and eligibility rates and response rates could be assessed relative to the rates achieved using the NPI file as a frame source.

Moreover, differences in eligibility rates and response rates between the office-based and non-office-based strata could be evaluated. If either type of rate differed substantially, future surveys could consider sampling physicians flagged as office-based and non-office-based at different rates. This would increase coverage compared to using only those physicians flagged as office-based while limiting the costs associated with fielding unproductive cases (those more likely to be ineligible). The trade-off with such an approach would be increased variance. Sample allocations could be established taking into account both cost and variance.

### References

- DiGaetano, R., (2013). Sample frame and related sample design issues for surveys of physicians and physician practices. *Evaluation and the Health Professions*, 36, 296-329. doi: 10.1177/0163278713496566.
- Klabunde, C.N., Lanier, D., Nadel, M.R., McLeod, C., Yuan, G., and Vernon, S.W. (2009). Colorectal cancer screening by primary care physicians: Recommendations and practices, 2006–2007. *American Journal of Preventive Medicine*, 37, 8–16. doi:10.1016/j.amepre.2009.03.008.
- Klabunde, C.N., Willis, G.B., McLeod, C.C., Dillman, D.A., Johnson, T.P., Greene, S.M., and Brown, M.L. (2012). Improving the quality of surveys of physicians and medical groups: A research agenda. *Evaluation and the Health Professions*, 35, 477-506. doi: 10.1177/0163278712458283.