

# A COMPARISON OF THE NATIONAL DISEASE AND THERAPEUTIC INDEX AND THE NATIONAL AMBULATORY MEDICAL CARE SURVEY TO EVALUATE ANTIBIOTIC USAGE

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## 1. Background

Antimicrobial resistance is rising in the United States, in part, due to the excessive and inappropriate use of antibiotics. In 1992, otitis media accounted for about one-fifth of the antibiotics prescribed (21%) in office-based physician practices in the U.S. (McCaig and Hughes, 1995). While antibiotics are effective for acute otitis media, they are not recommended for the treatment of uninfected middle ear fluid, a condition for which they are frequently prescribed. Other frequent diagnoses associated with prescribed antibiotics were unspecified upper respiratory infection (URI) (16%), bronchitis (13%), pharyngitis (12%) and sinusitis (12%). URI (i.e., common cold) acute bronchitis, and many cases of pharyngitis (i.e., sore throat) are viral conditions for which antibiotics are not effective.

Antibiotic resistance is a public health problem. The Department of Health and Human Services has two Healthy People (HP) 2010 objectives aimed at monitoring and improving the use of antimicrobial therapy ([www.health.gov/healthypeople](http://www.health.gov/healthypeople)). The first objective (14-18) is to "reduce the number of courses of antibiotics for ear infections for young children." The second objective (14-19) is to "reduce the number of courses of antibiotics prescribed for the sole diagnosis of the common cold." As such, interventions are being undertaken to reduce inappropriate prescribing of antibiotics.

To assess the impact of these efforts, we must accurately monitor trends in antibiotic usage. Two surveys, the National Disease and Therapeutic Index (NDTI) and the National Ambulatory Medical Care Survey (NAMCS), can be used to monitor office-based physician prescribing practices throughout the U.S. with the NAMCS having been selected as the data source for these objectives. We evaluated the characteristics of the two surveys as well as selected estimates at the national level for the years 1992-1996 in terms of antibiotic usage.

## 2. Methods

We evaluated the NDTI, conducted by IMS Health and the NAMCS, conducted by the National Center for Health Statistics (NCHS), Centers for Disease

Control and Prevention (CDC). The NDTI, continuously conducted since 1957, provides information about the patterns and treatment of disease encountered in office-based physician practices in the continental United States. The NAMCS, which began in 1973, collects data on the utilization of ambulatory medical care services provided by office-based physicians in the United States (Nelson and Woodwell, 1998; Schappert, 1996; Schappert and Nelson, 1999). It was conducted annually through 1981, again in 1985, and resumed an annual schedule in 1989.

A list of standard survey elements was compiled in order to evaluate and compare each survey methodology. The majority of these elements are recommended in the Best Practices for Survey and Public Opinion developed by the American Association of Public Opinion Research ([www.aapor.org/ethics/best.html](http://www.aapor.org/ethics/best.html)). Our evaluation included a comparison of the target population, sample frame, response rate, data collection methods, and estimation procedures. A complete list of the elements used to evaluate each survey methodology is presented in Table 1.

In order to compare estimates of antibiotic usage between the two surveys, we selected two respiratory diseases, pharyngitis (i.e., sore throat) and upper respiratory infection (URI) (i.e., common cold), because antibiotics are sometimes inappropriately prescribed for pharyngitis and should never be prescribed for URI. All analyses used weighted data. All-listed diagnoses were coded using the *International Classification of Diseases, 9<sup>th</sup> Revision, Clinical Modification* (ICD-9-CM). Pharyngitis was defined as ICD-9-CM codes 34, 462, 463 and URI as ICD-9-CM codes 460 and 465. Antibiotic agents were grouped into classes (e.g., amoxicillin). Amoxicillin was selected as the antibiotic of interest because it is a recommended treatment of pharyngitis caused by group A streptococcal infection (American Academy of Pediatrics, 2000) and is the most commonly prescribed antibiotic at physician office visits (Nelson and Woodwell, 1998). Although the NDTI includes patient contacts in other settings (e.g., house call, hospital, telephone, and nursing home), this analysis was limited to office contacts so that the patient encounters would be comparable for both surveys. SAS<sup>®</sup> was used for data management (SAS, 1990) and SUDAAN for variance estimation (Shah *et al.*, 1997). We compared

point estimates and the 95% confidence intervals for the years 1992 through 1996 from the two surveys for pharyngitis and URI for the United States. For each diagnosis, we estimated the number of patient encounters and the percent of patient encounters where amoxicillin was prescribed.

### 3. Results

#### 3.1 National Disease and Therapeutic Index

The NDTI is a sample survey of nonfederally employed U.S. physicians who provide "office-based, patient care" as classified by the American Medical Association (AMA) or the American Osteopathic Association (AOA) conducted by IMS Health a private organization. Physicians who practice in the specialties of anesthesiology, radiology, and pathology are excluded. The survey is based on a two-stage stratified cluster design (Table 1). Physicians, stratified by specialty, are sampled in the first stage; then two consecutive physician workdays are sampled per calendar quarter. Physicians are permitted to remain in the survey as long as they wish and generally participate for less than 3 years. New physicians are added as needed. The method for replacing physicians that "drop out" is proprietary.

NDTI sample units are physician workdays. The universe of physician workdays is calculated each month for each specialty/region category which is based on an independent telephone survey of more than 2,200 physicians per month. Physicians are stratified by 27 speciality groups and 4 geographic regions which correspond to the US Census regions (i.e., Northeast, Midwest, South, and West). Approximately, 1,180 physicians report on all patient contacts during two consecutive workdays per calendar quarter and about 340,000 case records on these contacts are completed annually. The response rate is considered proprietary information; however, staff from IMS Health stated that it is lower than that of government surveys.

Sample weights are applied to each monthly sample and are assigned to reflect the sample design and physician nonresponse. In addition to monthly estimates, monthly samples can be aggregated to produce quarterly and annual estimates. Weighted monthly samples, generally in the form of summary tables, are available for purchase two months after data collection is complete. Sample design parameters are available such that utilization of complex survey software in order to calculate the correct variance estimate is facilitated. The NDTI can provide national and regional (i.e., Northeast, Midwest, South, and West) estimates.

Physicians are initially contacted by an IMS telephone recruiter. Upon agreeing to participate in the

survey, they are mailed a case record book which includes general instructions, reporting dates, and detailed instructions for completing the case record for each patient encounter on the sampled workdays. Physicians are paid an undisclosed amount for their time to participate in the survey.

Case record reporting for each patient encounter includes a diagnosis or reason for the visit/contact using the ICD-9-CM codes. An unlimited number of diagnoses may be captured for each visit. For each diagnosis, unlimited prescription or over-the-counter medications may be coded using USC codes. The coding system also includes a "No drug given" category. Additional drug information is provided including dosage and route of administration, and days of therapy. Detailed patient demographic and clinical information is recorded for each patient. Information provided includes blood pressure and cholesterol measurements, new or returning patient (if returning, how many visits in the previous 12 months), smoking status of the patient, insurance coverage, etc.

#### 3.2 National Ambulatory Medical Care Survey

The NAMCS is a sample survey of nonfederally employed U.S. physicians who were classified by the AMA and the AOA as providing "office-based, patient care" (Nelson and Woodwell, 1998; Schappert, 1996; Schappert and Nelson, 1999). As with NDTI, the specialties of anesthesiology, radiology, and pathology are excluded. The NAMCS uses a multistage probability design involving samples of primary sampling units (PSU's), physician practices within PSU's, and patient visits within physician practices. PSU's are counties, groups of counties, county equivalents or towns and townships from all 50 states and the District of Columbia. Physicians participate for one week during the calendar year and can participate only once every three years.

NAMCS sample units are patient visits. In 1997, a sample of 2,498 physicians was selected from the AMA and AOA master files and were stratified by 15 speciality groups. Approximately 1,800 physicians met the inclusion criteria (72%); and 1,246 participated for a response rate of 69%. A total of 24,715 Patient Record forms were submitted in 1997 (Woodwell, 1999). Sample weights are applied to the sample records to produce national annual estimates of patient visits and drug mentions and are assigned to reflect the sample design, nonresponse, and U.S. population. Weighted samples are available free of charge on the Internet approximately eleven months after data collection is complete ([www.cdc.gov/nchs/about/major/ahcd/ahcd1.htm](http://www.cdc.gov/nchs/about/major/ahcd/ahcd1.htm)) and on public use data tapes and CD-ROM for a nominal charge. Sample design parameters are not available on public use

data files in order to protect the confidentiality of the sampled physicians and patients. However, in the public use file documentation, tables are provided with coefficients in order to calculate the approximate relative standard error. Researchers who require access to key design variables can conduct analyses through NCHS' Research Data Center in Hyattsville, Maryland so research can be conducted without compromising respondent confidentiality.

Physicians initially receive an introductory letter from the NCHS Director five weeks prior to the reporting period. Physicians are then contacted by a Bureau of the Census field representative for a personal interview. Upon agreeing to participate in the survey, the field representative trains the physician on visit sampling procedures and completion of the Patient Record form. The physician is given a packet of materials on NAMCS including articles which use NAMCS data, fact sheets for each speciality, and a current Advance Data report. Physicians voluntarily agree to participate without compensation. Sample physicians are asked to complete Patient Record forms for a systematic random sample of patient office visits during a randomly assigned one-week reporting period. Telephone contacts are excluded.

Up to three diagnoses (i.e., one primary and two additional diagnoses) can be recorded per visit. These are coded using ICD-9-CM codes. Up to six medications that are either prescription or over-the-counter can be recorded per visit; however, they are not linked to the diagnosis. In 1992, 1993, and 1994, up to five medications were recorded per visit. Medications are coded according to a drug coding system developed by NCHS (Koch, 1982). For each patient visit, detailed patient demographic and visit information is recorded including diagnostic/screening services ordered or provided, non-medication therapy and counseling, new or returning patient, insurance coverage, time spent with the physician, etc.

### 3.3 Comparison of NDTI and NAMCS Estimates

Table 2 shows the number of NAMCS and NDTI patient encounters for pharyngitis (i.e., sore throat) and the percent of patient encounters where amoxicillin was prescribed for the years 1992 through 1996. Table 3 shows the same estimates for URI (i.e., common cold). We are beginning to examine estimates from the two surveys and a detailed comparison will appear in a forthcoming paper.

## 4. Conclusion

More emphasis is being given to reporting of key elements of sample surveys. If all of the survey

elements are known then this allows for a fair comparison of survey methodology, data quality, and accuracy and precision of the survey estimates across the different sample surveys. We were able to obtain all the information regarding the key elements in the NAMCS, a federally sponsored survey. For the NDTI, a private-sector sponsored survey, we were unable to obtain information on response rate; percent of physicians that remain on the panel for more than one year; average length of time a physician remains on the panel; number of sample physicians never contacted; reassignment of physician workdays; amount of money that physicians are paid to participate; and the method for replacing "dropout" physicians. One of the criteria for selecting a data source for the 2010 HP objectives is that the data are valid and reliable and are derived from currently established, nationally representative data systems. The NDTI only covers the continental United States; therefore, it is not nationally representative. In addition, since information on many of the key elements of the NDTI is proprietary, the validity and reliability of the data are unknown.

While both the NDTI and the NAMCS are surveys of office-based physicians, there are differences. The NAMCS is a probability sample survey and the NDTI is not. In the NDTI, estimates can be produced for visits which occur outside of the physician's office, whereas in the NAMCS telephone contacts and visits made outside of the physician's office are excluded. The NDTI can produce monthly, quarterly, and annual estimates while the NAMCS can only produce annual estimates. The NDTI collects more detailed drug information, such as dosage and route of administration than the NAMCS. Medication is linked to diagnosis on the NDTI whereas there is no linkage on the NAMCS. NDTI data are more timely than NAMCS data. There is a substantial charge for purchasing NDTI data; however, NAMCS data can be downloaded from the Internet at no charge and other formats are available for a nominal fee. NDTI data with the critical sample design variables and sample weights for appropriate variance estimation can be purchased. Published RSE approximation tables must be used for the NAMCS or arrangements must be made to use the NCHS Data Research Center in order to access the variance files.

Timeliness is a critical component for many who use sample surveys. If one needs drug usage data quickly or needs to know the percent of telephone drug prescribing and doesn't need a nationally representative sample, the NDTI is the sample survey which would meet your requirements. NAMCS in combination with the National Hospital Ambulatory Medical Care Survey (i.e., a survey of visits to hospital outpatient and emergency

departments) was selected to monitor the HP2010 objectives because it produces unbiased estimates which are nationally representative; the key survey elements are known; and timeliness is not critical.

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Table 1  
Comparison of the National Disease and Therapeutic Index (NDTI)  
and the National Ambulatory Medical Care Survey (NAMCS)

Survey Element	NDTI	NAMCS
Target Universe	All patient encounters	Face-to-face office visits
Sample Design	2-stage stratified cluster design	3-stage stratified cluster probability design
Physician Sampling	Substitution of dropouts - methodology proprietary	No substitution of dropouts
Sample Duration	Physicians report quarterly until they "drop-out"	New sample of non-federal physicians annually
Physician Sample Size	Proprietary	2,500-3,500 physicians annually
Eligible Physicians	Proprietary	1,800-2,500 physicians annually
Respondents	3,000-3,500 physicians annually	1,250-1,750 physicians annually
Observed Patient Encounters	~340,000 patients encounters annually	~25,000-35,000 face-to-face office visits annually
Reporting period	2 consecutive workdays per calendar quarter	1 week per calendar year
Coverage	Continental U.S.	50 states and the District of Columbia
Periodicity of reporting	National and regional data monthly, quarterly, and annually	National and regional data annually
Physician Recruitment/Induction	Telephone and mail	Personal interview
Incentives	Monetary payment and data	Data
Timeliness of data release	20 <sup>th</sup> day of month after data collection ends	December following year that data collection ends
Response Rate	Proprietary	69% (in 1997)
Costs for data	Substantial charge	Free or nominal charge
Data Format	CD-ROM, Publications, Special Analyses	CD-ROM, Tape, Downloadable file
Variance Estimation Procedures	Sample design characteristics for appropriate variance estimation can be purchased.	Published RSE approximation tables, methods available to obtain/use variance file

Table 2

Patient Encounters and Patient Encounters Prescribed Amoxicillin, Pharyngitis, NAMCS and NDTI, U.S., 1992-1996

Year	Patient Encounters				Patient Encounters Prescribed Amoxicillin			
	NAMCS		NDTI		NAMCS		NDTI	
	N (in 1,000's)	(95% CI*)	N (in 1,000's)	(95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	
1992	26444	(21136, 31752)	24634	(22418, 26849)	34.11	(27.37, 40.85)	37.03	(33.85, 40.21)
1993	19209	(15983, 22435)	27978	(25334, 30622)	30.36	(25.01, 35.71)	39.92	(36.82, 43.02)
1994	19147	(15411, 22883)	25931	(23257, 28605)	38.21	(32.76, 43.66)	39.50	(36.19, 42.81)
1995	19956	(16165, 23747)	26136	(23359, 28913)	38.28	(32.58, 43.98)	39.74	(36.53, 42.95)
1996	18730	(15120, 22340)	22939	(20566, 25312)	38.64	(32.54, 44.74)	36.51	(33.61, 39.41)

\*95% Confidence Interval

Table 3

Patient Encounters and Patient Encounters Prescribed Amoxicillin, Upper Respiratory Infection, NAMCS and NDTI, U.S., 1992-1996

Year	Patient Encounters				Patient Encounters Prescribed Amoxicillin			
	NAMCS		NDTI		NAMCS		NDTI	
	N (in 1,000's)	(95% CI*)	N (in 1,000's)	(95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	
1992	32154	(25161, 39147)	26786	(24488, 29084)	26.95	(21.23, 32.67)	25.95	(23.66, 28.24)
1993	27209	(22772, 31646)	30686	(27770, 33602)	27.58	(22.21, 32.95)	24.06	(21.51, 26.61)
1994	23460	(19620, 27300)	26712	(24080, 29345)	25.52	(21.38, 29.54)	24.64	(22.00, 27.29)
1995	29918	(24640, 35196)	27457	(24614, 30300)	27.68	(21.64, 33.72)	24.29	(21.80, 26.78)
1996	26569	(20934, 32204)	25227	(22637, 27817)	27.63	(20.57, 34.69)	21.53	(19.02, 24.04)

\*95% Confidence Interval