Trends in Children's Antibiotic Use:
1996 to 2001

MEPS

Research Findings

#23

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Abstract

In the mid-1990s, concerns about the overuse of antibiotics and the increasing prevalence of antibiotic-resistant bacterial infections in the United States prompted public health and professional organizations to launch national campaigns to promote the appropriate use of antibiotics. This report uses nationally representative data from the Medical Expenditure Panel Survey (MEPS) to examine antibiotic use by U.S. children for the years 1996-2001. From 1996 to 2001, the proportion of children who used an antibiotic during the year declined from 39.0 percent to 29.0 percent and the average number of antibiotic prescriptions for children declined from 0.9 to 0.5 per child. Use of antibiotics in the treatment of otitis media also declined. The proportion of all children for whom an antibiotic was prescribed to treat otitis media fell from 14.4 percent in 1996 to 11.5 percent in 2001. Trends in antibiotic use for subgroups of children defined by age, race/ethnicity, sex, income, insurance status, health status, and geography are also examined. From 1996-97 to 2000-01, the percentage of children with antibiotic use and the average number of prescriptions declined in each of the population subgroups under consideration.

The estimates in this report are based on the most recent data available at the time the report was written. However, selected elements of MEPS data may be revised on the basis of additional analyses, which could result in slightly different estimates from those shown here. Please check the MEPS Web site for the most current file releases.

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The Medical Expenditure Panel Survey (MEPS)

Background

The Medical Expenditure Panel Survey (MEPS) is conducted to provide nationally representative estimates of health care use, expenditures, sources of payment, and insurance coverage for the U.S. civilian noninstitutionalized population. MEPS is cosponsored by the Agency for Healthcare Research and Quality (AHRQ), formerly the Agency for Health Care Policy and Research, and the National Center for Health Statistics (NCHS).

MEPS comprises three component surveys: the Household Component (HC), the Medical Provider Component (MPC), and the Insurance Component (IC). The HC is the core survey, and it forms the basis for the MPC sample and part of the IC sample. Together these surveys yield comprehensive data that provide national estimates of the level and distribution of health care use and expenditures, support health services research, and can be used to assess health care policy implications.

MEPS is the third in a series of national probability surveys conducted by AHRQ on the financing and use of medical care in the United States. The National Medical Care Expenditure Survey (NMCES) was conducted in 1977, the National Medical Expenditure Survey (NMES) in 1987. Beginning in 1996, MEPS continues this series with design enhancements and efficiencies that provide a more current data resource to capture the changing dynamics of the health care delivery and insurance system.

The design efficiencies incorporated into MEPS are in accordance with the Department of Health and Human Services (DHHS) Survey Integration Plan of June 1995, which focused on consolidating DHHS surveys, achieving cost efficiencies, reducing respondent burden, and enhancing analytical capacities. To accommodate these goals, new MEPS design features include linkage with the National Health Interview Survey (NHIS), from which the sample for the MEPS HC is drawn, and enhanced longitudinal data collection for core survey components. The MEPS HC augments NHIS by selecting a sample of NHIS respondents, collecting additional data on their health care expenditures, and linking these data with additional information collected from the respondents' medical providers, employers, and insurance providers.

Household Component

The MEPS HC, a nationally representative survey of the U.S. civilian noninstitutionalized population, collects medical expenditure data at both the person and household levels. The HC collects detailed data on demographic characteristics, health conditions, health status, use of medical care services, charges and payments, access to care, satisfaction with care, health insurance coverage, income, and employment.

The HC uses an overlapping panel design in which data are collected through a preliminary contact followed by a series of five rounds of interviews over a $2^{1}/_{2}$-year period. Using computer-assisted personal interviewing (CAPI) technology, data on medical expenditures and use for 2 calendar years are collected from each household. This series of data collection rounds is launched each subsequent year on a new sample of households to provide overlapping panels of survey data and, when combined with other ongoing panels, will provide continuous and current estimates of health care expenditures.

The sampling frame for the MEPS HC is drawn from respondents to NHIS, conducted by NCHS. NHIS provides a nationally representative sample of the U.S. civilian noninstitutionalized population, with oversampling of Hispanics and blacks.

Medical Provider Component

The MEPS MPC supplements and validates information on medical care events reported in the MEPS HC by contacting medical providers and pharmacies identified by household respondents. The MPC sample includes all hospitals, hospital physicians, home health agencies, and pharmacies reported in the HC. Also included in the MPC are all office-based physicians:

- Providing care for HC respondents receiving Medicaid.
- Associated with a 75-percent sample of households receiving care through an HMO (health maintenance organization) or managed care plan.

- Associated with a 25-percent sample of the remaining households.

Data are collected on medical and financial characteristics of medical and pharmacy events reported by HC respondents, including:

- Diagnoses coded according to ICD-9 (9th Revision, International Classification of Diseases) and DSM-IV (Fourth Edition, Diagnostic and Statistical Manual of Mental Disorders).
- Physician procedure codes classified by CPT-4 (Current Procedural Terminology, Version 4).
- Inpatient stay codes classified by DRG (diagnosis-related group).
- Prescriptions coded by national drug code (NDC), medication names, strength, and quantity dispensed.
- Charges, payments, and the reasons for any difference between charges and payments.

The MPC is conducted through telephone interviews and mailed survey materials.

Insurance Component

The MEPS IC collects data on health insurance plans obtained through private and public-sector employers. Data obtained in the IC include the number and types of private insurance plans offered, benefits associated with these plans, premiums, contributions by employers and employees, and employer characteristics.

Establishments participating in the MEPS IC are selected through three sampling frames:

- A list of employers or other insurance providers identified by MEPS HC respondents who report having private health insurance at the Round 1 interview.
- A Bureau of the Census list frame of private-sector business establishments.
- The Census of Governments from the Bureau of the Census.

To provide an integrated picture of health insurance, data collected from the first sampling frame (employers and other insurance providers) are linked back to data provided by the MEPS HC respondents. Data from the other three sampling frames are collected to provide annual national and State estimates of the supply of private health insurance available to American workers and to evaluate policy issues pertaining to

health insurance. Since 2000, the Bureau of Economic Analysis has used national estimates of employer contributions to group health insurance from the MEPS IC in the computation of Gross Domestic Product (GDP).

The MEPS IC is an annual panel survey. Data are collected from the selected organizations through a prescreening telephone interview, a mailed questionnaire, and a telephone followup for nonrespondents.

Survey Management

MEPS data are collected under the authority of the Public Health Service Act. They are edited and published in accordance with the confidentiality provisions of this act and the Privacy Act. NCHS provides consultation and technical assistance.

As soon as data collection and editing are completed, the MEPS survey data are released to the public in staged releases of summary reports and microdata files. Summary reports are released as printed documents and electronic files. Microdata files are released on CD-ROM and/or as electronic files.

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Trends in Children's Antibiotic Use: 1996 to 2001

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Introduction

Since their discovery in the 1940s, antibiotics have transformed medical care and dramatically reduced illness and death from infectious diseases (Centers for Disease Control and Prevention, 2003). Increased use of these drugs throughout the 1980s and early 1990s, however, led to concerns about the overuse of antibiotics and the increasing prevalence of antibiotic-resistant bacterial infections. Children are a population of particular concern because they have the highest rates of antibiotic use and the highest rates of infection with antibiotic-resistant pathogens of any age group (Perz, Craig, Coffey, et al., 2002). Further, the majority of antibiotics prescribed for children in the United States are for respiratory tract infections such as otitis media, bronchitis, and pharyngitis (data from the Medical Expenditure Panel Survey for 1996-2001, not shown), and much of this prescribing is for viral conditions for which antibiotics are not indicated (McCaig, Besser, and Hughes, 2002).

Since the mid-1990s concerns about the overuse of antibiotics and the increasing prevalence of antibiotic-resistant bacterial infections have prompted the Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), and other public health and professional organizations to launch national campaigns to promote the appropriate use of antibiotics. Several recent studies (Finkelstein, Stille, Nordin, et al., 2003; Mainous, Hueston, Davis, et al., 2003; McCaig, Besser, and Hughes, 2002; Steinman, Gonzales, Linder, et al., 2003) document sharp decreases, beginning in the mid-1990s, in overall antibiotic use by children and in the use of antibiotics to treat children's respiratory tract infections such as otitis media and bronchitis.

This report presents nationally representative estimates from the Medical Expenditure Panel Survey (MEPS) of antibiotic use by children age 14 and under for the years 1996 through 2001. The study examines trends in two measures of antibiotic use—the percentage of children who used at least one antibiotic and the average number of prescriptions—and the contributions to these trends of changes in ambulatory visits and changes in antibiotic use for children with a visit. In addition, it looks at differences in antibiotic use across groups of children defined by race/ethnicity, income, insurance status, and other characteristics. Finally, it examines trends and differences across groups in the use of antibiotics to treat otitis media.

Throughout this report only differences in estimates that are statistically significant at the p ≤ .05 level are discussed in the text. In MEPS, information is obtained on drugs that are purchased or otherwise acquired by members of the household. There may be instances when a drug was prescribed but not acquired or when a drug was acquired but not used. However, for purposes of this report, the terms "prescribed," "purchased," and "used" are interchangeable. The Technical Appendix provides substantial detail on the sample design and definitions of measures used in this report.

Findings

Overall Trends in Antibiotic Use

Table 1 presents estimates of overall trends in antibiotic use. In 1996, 39.0 percent of the approximately 60 million children age 14 and under in the United States had at least one prescription for an oral antibiotic. By 2001 the proportion of children with antibiotic use had fallen to 29.0 percent. The average number of antibiotic prescriptions also declined over this time period, from 0.9 per child in 1996 to 0.5 per child in 2001. This decline resulted both because of a lower percentage of children with any antibiotic use and because children who used antibiotics had fewer prescriptions. Among children with use, the average number of antibiotic prescriptions per child fell from 2.4 in 1996 to 1.9 in 2001.

Table 1 also shows that declines in antibiotic use were not steady during the years studied. Instead, large reductions in the proportion with use and in the

> **From 1996 to 2001, the proportion of children who used an antibiotic during the year declined from 39 percent to 29 percent.**

average number of prescriptions occurred in the years 1996 through 1998. These initial declines were followed by a flattening of the trends for both measures of antibiotic use from 1998 through 2001.

Percentage With Use

Table 2 presents estimates of the percentage of children who used at least one antibiotic during the year by selected population characteristics. Trends in antibiotic use are examined by comparing average annual estimates for 1996-97 with estimates for 2000-01. Pooling two years of data increases the precision of the estimates and provides a sufficient sample to produce estimates for smaller subgroups of children, such as uninsured children and children in fair or poor health.

Before a child receives an antibiotic, there must be either a visit or a phone consultation with a physician or other practitioner with the authority to prescribe drugs. The practitioner then decides whether to prescribe an antibiotic for the child. Both components of this process are potentially important determinants of trends, and differences across groups, in overall antibiotic use. Accordingly, Table 2 presents estimates of the proportion of children with an ambulatory visit and also presents estimates of conditional use—the proportion of children with an ambulatory visit who were prescribed an antibiotic.[1] Since general checkups, well-child visits, sick visits, and phone consultations are all included in the measure of ambulatory visits, the percentage of children with an ambulatory visit indicates contact with the health care system rather than the intention to seek care for an acute problem.

Overall Trends

The overall proportion of children using antibiotics during the year fell from 36.3 percent in 1996-97 to 28.8 percent in 2000-01. There was no statistically significant change in visits, as approximately three-

> **There was no change in overall ambulatory visits from 1996 to 2001, but there was a large decrease in antibiotic use among children with a visit.**

quarters of children had at least one ambulatory visit in both 1996-97 and 2000-01. There was, however, a large decrease in antibiotic use among children with an ambulatory care visit, from 46.5 percent in 1996-97 to 37.7 percent in 2000-01.

Age

In both 1996-97 and 2000-01, the overall percentage of children using an antibiotic declined with age across all three age categories. In 1996-97, nearly half (46.0 percent) of children age 4 and under used an antibiotic, compared to 37.6 percent of children ages 5-9 and 25.2 percent of children ages 10-14. Differences in visits and in conditional use both played a role in the overall differences in use. The percent of children with a visit and the percent of children with a visit who got an antibiotic both declined with age.

From 1996-97 to 2000-01 the percentage of children with a visit showed little or no change for any age group. Among children with an ambulatory care visit, however, the proportion of children who used an antibiotic showed large decreases in all three age groups, resulting in a drop in the overall rate of antibiotic use for all three age groups. By 2000-01, the rate of antibiotic use had declined to 37.5 percent for children age 4 and under, 29.6 percent for children ages 5-9, and 19.8 percent for children ages 10-14.

Race/Ethnicity

In both 1996-97 and 2000-01, there were differences across racial/ethnic groups in the overall percentage of children who were prescribed an antibiotic. In 1996-97, the proportion of white/other children with antibiotic use (41.5 percent) was higher than the proportion for Hispanic children (29.3 percent) and more than double the proportion for black children (20.6 percent). The difference in use between Hispanic and black children was also statistically significant. Differences in overall antibiotic use resulted from differences across racial/ethnic groups in both the percentage of children with a visit and the rate of antibiotic use conditional on a visit.

From 1996-97 to 2000-01, the percentage of children with a visit did not change for any of the racial/ethnic groups, but the percentage of children with a visit who were prescribed an antibiotic declined sharply in all three groups. As a result the overall rate of antibiotic use fell for all groups, so that 33.2 percent of white/other children, 24.1 percent of Hispanic

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[1] In conducting these analyses, no attempt was made to link specific visits and antibiotic purchases. Instead, person-level variables were constructed that indicate whether a child ever had an ambulatory visit during the year and whether a child ever was prescribed an antibiotic during the year.

children, and 15.6 percent of black children used an antibiotic in 2000-01.

Sex

There were no statistically significant differences between girls and boys in antibiotic use or ambulatory care visits in either 1996-97 or 2000-01.

Income, Health Insurance Status, and Perceived Health Status

The results for income, health insurance status, and perceived health status are similar to those observed for age and race/ethnicity. Differences in overall rates of antibiotic use across groups of children defined by income, insurance status, and health status persisted from 1996-97 to 2000-01. Over the same time period, the percent with a visit showed little or no change and the conditional rate of use showed a large decline in all groups of children.

In 2000-01 the overall rate of use increased steadily with income, as 21.5 percent of poor/near poor, 25.0 percent of low-income, 31.0 percent of middle-income, and 34.5 percent of high-income children used an antibiotic during the year.

Overall use varied by health insurance coverage. The proportion using an antibiotic was 32.0 percent for children with any private insurance, 24.0 percent for children with public coverage only, and 17.8 percent for uninsured children.

Overall use decreased steadily as health status improved. Children in fair or poor health were the most likely (43.5 percent) to use an antibiotic, compared to 32.1 percent of children in good health and 27.7 percent of children in excellent or very good health.

MSA and Census Region

In 1996-97 the percentage of children with antibiotic use was somewhat lower for children who lived in metropolitan statistical areas (MSAs) than for children living in non-MSA areas (35.6 percent vs. 39.4 percent). The percent with use fell for both groups over the time period of our study, and the difference in use persisted through 2000-01.

In 1996-97, Midwestern children had a higher rate of antibiotic use (40.4 percent) than children from the other three Census regions. By 2000-01, Midwestern children still had higher rates of use than children from the West, but there was no statistically significant difference in use between the Midwest and the other two regions.

Average Number of Prescriptions

Table 3 presents estimates of the average number of antibiotic prescriptions for all children and the average number of prescriptions for children who had at least one antibiotic by selected population characteristics. As in Table 2, trends are examined by comparing average annual estimates for 1996-97 with estimates for 2000-01.

Overall Trends

The average annual number of antibiotic prescriptions purchased for children age 14 and under in the United States declined by about one-third, from 48.9 million in 1996-97 to 32.9 million in 2000-01. Overall, the average number of antibiotic prescriptions fell from 0.8 per child in 1996-97 to 0.5 per child in 2000-01. This decline resulted both because a lower percentage of children had any antibiotic use (as documented in the previous section) and because children who used antibiotics had fewer prescriptions. Among children with use, average prescriptions fell from 2.3 in 1996-97 to 1.9 in 2000-01.

Age

The overall average number of prescriptions fell for children in each age group from 1996-97 to 2000-01, and the number of prescriptions for children with any antibiotic use fell for children age 4 and under and children ages 5-9. Differences across age groups in the average number of prescriptions persisted throughout this time period. In 2000-01, children age 4 and under had the most prescriptions (0.8 per child), children ages 5-9 had the second most (0.5 per child), and children ages 10-14 had the fewest (0.3 per child). A similar pattern is seen among children who had at least one antibiotic, with children age 4 and under using an average of 2.1 prescriptions, children ages 5-9 using 1.8 prescriptions, and children ages 10-14 using 1.6 prescriptions.

Race/Ethnicity

The overall average number of prescriptions declined for all three racial/ethnic groups from 1996-97 to 2000-01, but the average number of prescriptions among children who used any antibiotics showed a statistically significant decline only for children in the white/other group. However, in 2000-01, white/other children still had the highest average number of prescriptions: 0.6 per child, compared to 0.4 per child for Hispanics and 0.3 per child for blacks.

Sex

There were no statistically significant differences between girls and boys in the average number of prescriptions purchased.

Income

The overall average number of prescriptions declined for children in all income groups from 1996-97 to 2000-01, and the average number of prescriptions among children with use declined for all except low-income children. In 2000-01, high-income children had an average of 0.7 prescriptions per child, middle-income children had 0.6 prescriptions per child, and low-income and poor/near poor children had an average of 0.4 prescriptions per child.

Health Insurance Status

The overall average number of prescriptions declined for children in all insurance groups from 1996-97 to 2000-01, but the average prescriptions among children with use declined only for children with any private insurance. In 2000-01, the group with any private insurance had the highest overall average number of prescriptions (0.6 per child). Children with only public insurance had the next highest average (0.4 per child) and uninsured children used the fewest prescriptions (0.3 per child).

Perceived Health Status

The overall average number of prescriptions declined for children in all health status groups from 1996-97 to 2000-01, and the average prescriptions among children with use declined for all children except those in fair or poor health. The number of antibiotic prescriptions declined as health status improved in both time periods. In 2000-01, children in fair or poor health used the most prescriptions overall (1.4 per child), children in good health used the second most (0.6 per child), and children in excellent or very good health used the fewest (0.5 per child). Among children with use, children in fair or poor health used an average of 3.1 prescriptions, compared to 2.0 prescriptions for children in good health and 1.8 prescriptions for children in excellent or very good health.

MSA and Census Region

The overall average number of prescriptions and the average among children with use fell from 1996-97 to 2000-01 for children living in MSAs and in non-MSA areas. In 2000-01, children who lived in non-MSA areas used slightly more prescriptions per child (0.6 vs. 0.5).

The overall average number of prescriptions and the average among children with use fell from 1996-97 to 2000-01 for children in all four Census regions. In 2000-01, Southern and Midwestern children both used 0.6 prescriptions per child. Average prescriptions used were significantly higher for Midwestern children than for Northeastern and Western children.

Trends and Differences in Treatment of Otitis Media

Tables 4 and 5 present information on trends in the treatment of otitis media. These condition-specific trends are of interest for several reasons. First, otitis media, or ear infection, is the most common reason that children receive an antibiotic. From 1996 to 2001, otitis media accounted for about one-third of all antibiotic use by children age 14 and under in the United States (data not shown). Second, the use of antibiotics in the treatment of otitis media is often, but not always, appropriate. Campaigns to encourage the appropriate use of antibiotics, therefore, may be expected to have an effect on the treatment of this condition. Finally, the percentage of children with an ambulatory visit for otitis media provides information on differences across groups and trends over time in the propensity to seek treatment for a highly prevalent acute condition.

Overall Trends

Table 4 presents trends for all children, regardless of whether they were reported to have otitis media during the year. From 1996 to 2001, the proportion of all children who took at least one antibiotic to treat otitis media fell from 14.4 percent to 11.5 percent. Similar to the trends for overall antibiotic use presented in Table 1, Table 4 shows that the decline in antibiotic use in the treatment of otitis media was not steady during the years of the study. Instead, a

> **From 1996 to 2001, the proportion of all children who took at least one antibiotic to treat otitis media fell from 14.4 percent to 11.5 percent.**

large reduction in the percentage with use occurred from 1996 through 1999 and was then followed by a flattening of the trend from 1999 through 2001.

In contrast to the results for overall antibiotic use, however, reductions in the use of antibiotics to treat otitis media were driven by declines in ambulatory visits rather than declines in the rate of conditional use. The percent of children with an ambulatory visit to seek treatment for otitis media fell from 15.1 percent in 1996 to 12.7 percent in 2001. Similarly, the proportion of children reported to have otitis media during the year fell from 21.1 percent in 1996 to 16.4 percent in 2001. Among children with an ambulatory visit for otitis media, there was no statistically significant change in the percentage prescribed an antibiotic to treat their ear infection. The intensity of antibiotic use did decline, however, as the average number of prescriptions for children with use fell from 2.2 in 1996 to 1.8 in 2001.

Table 5 focuses on the population of children reported to have otitis media and uses pooled data for the six years from 1996 through 2001. Pooling six years of data increases the precision of the estimates and provides a sufficient sample to produce estimates for smaller groups of children, such as the uninsured or children in fair/poor health.

Overall, an average annual total of 10.4 million children were reported to have otitis media during the time period of the study. Nearly four-fifths (78.1 percent) had an ambulatory visit to seek treatment for their otitis media and 70.0 percent were prescribed an antibiotic to treat this condition. Among children with an ambulatory visit for otitis media, 78.6 percent got an antibiotic to treat this condition.[2]

Because Table 5 uses pooled data for all six years, the focus is on differences across groups rather than trends in use. These differences for groups defined by age, race/ethnicity, and insurance status are highlighted in the following text.

Age

The youngest children were the most likely to have their otitis media treated with an antibiotic. Nearly

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[2] Among children reported to have otitis media during the year, some (about 9 percent) were reported to have used an antibiotic for this condition but were not reported to have made an ambulatory visit specifically for otitis media. These children are included among the 70 percent of children who used an antibiotic for otitis media. Their antibiotic use is not captured, however, in the calculation of rates of antibiotic use among children with a visit for otitis media.

three-quarters (73.2 percent) of children age 4 and under used an antibiotic, compared to 66.4 percent of children ages 5-9 and 62.5 percent of children ages 10-14. There was no statistically significant difference across age groups in the percentage of children with a visit for otitis media, but the rate of antibiotic use conditional on a visit was higher for children age 4 and under (81.9 percent) than for children ages 5-9 (75.5 percent) or children ages 10-14 (69.5 percent). Among children who used at least one antibiotic, children age 4 and under also had more prescriptions than the other age groups, an average of 2.1.

Race/Ethnicity

White/other children were more likely (71.7 percent) than Hispanic children (64.9 percent) or black children (61.9 percent) to use an antibiotic to treat their otitis media. Differences in visits and conditional rates of use both played a role in this overall difference. White/other children were more likely (79.5 percent) to have an ambulatory visit for otitis media than Hispanic children (74.1 percent) or black children (70.7 percent). White/other children were also more likely (80.0 percent) than Hispanic children (74.2 percent) or black children (70.7 percent) to be prescribed an antibiotic for otitis media if they had an ambulatory visit for the condition.

Health Insurance Status

Children with any private insurance were more likely (72.2 percent) than children with only public insurance (65.3 percent) or uninsured children (57.1 percent) to use an antibiotic to treat their otitis media. Differences in visits and conditional rates of use both played a role in the overall difference. Children with any private insurance were more likely (79.7 percent) to have an ambulatory visit than children with only public insurance (74.3 percent) or uninsured children (69.0 percent). Children with any private insurance were also more likely (80.2 percent) than children with only public insurance (74.3 percent) or uninsured children (68.7 percent) to use an antibiotic for otitis media if they had an ambulatory visit for the condition. Among children who used at least one antibiotic, children with any private insurance also had more prescriptions than the other groups.

Summary and Conclusions

In the mid-1990s, concerns about the overuse of antibiotics and the increasing prevalence of antibiotic-resistant bacterial infections prompted the Centers for Disease Control and Prevention, the American Academy of Pediatrics, and other public health and professional organizations to launch national campaigns to promote the appropriate use of antibiotics. This report uses nationally representative data from MEPS to examine antibiotic use by U.S. children in the years 1996-2001. Like previous studies (Finkelstein, Stille, Nordin, et al., 2003; Mainous, Hueston, Davis, et al., 2003; McCaig, Besser, and Hughes, 2002; Steinman, Gonzales, Linder, et al., 2003), this study finds sharp declines in use beginning in the mid-1990s. From 1996 to 2001, the proportion of children age 14 and under who used an antibiotic declined from 39.0 percent to 29.0 percent and the average number of antibiotic prescriptions for children declined from 0.9 to 0.5 per child. Use of antibiotics in the treatment of otitis media also declined. The proportion of all children who took an antibiotic to treat otitis media fell from 14.4 percent in 1996 to 11.5 percent in 2001. Trends in antibiotic use for groups of children defined by characteristics such as race/ethnicity, income, and insurance status show reductions in use from 1996-97 to 2000-01 in all groups.

Reductions in antibiotic use were not steady over the period studied. Instead, large reductions in use occurred from 1996 through 1998, followed by a flattening of the trend from 1998 through 2001. Mainous and colleagues (2003) had similar findings and suggested that the initial information released by the CDC in 1995, along with journal articles and news reports, appear to have been more effective than the specific recommendations on judicious use issued by the CDC and the AAP and disseminated in 1998. McCaig and colleagues (2002) also noted that reduced antimicrobial use coincided with increased media attention to the problem of antimicrobial resistance and with efforts by many organizations to promote appropriate use.

The contributions of changes in ambulatory visits and changes in conditional use to trends in the percentage of children with antibiotic use were also examined. Since general checkups and well-child visits are included in the overall measure of ambulatory visits, the percentage of children with any ambulatory visit during the year indicates contact with the health care system rather than the intention to seek care for an acute problem. Examination of overall use showed no change from 1996-97 to 2000-01 in the proportion of children with an ambulatory visit. Among children with a visit, however, the rate of antibiotic use decreased significantly in almost every subgroup of children. With otitis media, by contrast, sharp declines were found both in the percentage of children with an ambulatory visit to seek treatment for this condition and in the percent of children reported to have otitis media during the year. At the same time, the conditional rate of antibiotic use in the treatment of otitis media did not change.

McCaig and colleagues (2002) found similar results for the contributions of visits and visit-based prescribing to trends in the use of antibiotics overall and in the treatment of otitis media. Finkelstein and colleagues (2003) also found a large reduction in the diagnosis of otitis media but no reduction in antibiotic use if there was a diagnosis of otitis media. The observed reduction in the proportion of children diagnosed with otitis media may reflect either changes in the likelihood that parents sought care for this condition or changes in clinicians' diagnostic thresholds. The results in this report are consistent with either explanation.

In addition to examining overall trends, this report examines trends in antibiotic use for subgroups of children defined by age, race/ethnicity, sex, income, insurance status, health status, and geography. From 1996-97 to 2000-01, the percentage of children with antibiotic use and the average number of prescriptions declined in each of the population subgroups under consideration. This suggests that the effects of campaigns to promote the appropriate use of antibiotics were widespread. It also suggests that, in 1996-97, there was a perceived overuse of antibiotics even among groups of children that had low levels of use relative to their peers. One consequence of the widespread decline was that differences across groups in overall antibiotic use persisted throughout the time period of our study. Using pooled data, the researchers also found differences across groups in the use of antibiotics to treat otitis media.

References

Centers for Disease Control and Prevention. Get smart: know when antibiotics work. Web site: http://www.cdc.gov/drugresistance/community/. Accessed Oct. 2004.

Cohen J. Design and methods of the Medical Expenditure Panel Survey Household Component. Rockville (MD): Agency for Health Care Policy and Research; 1997. MEPS Methodology Report No. 1. AHRQ Pub. No. 97-0026.

Cohen S. Sample design of the 1996 Medical Expenditure Panel Survey Household Component. Rockville (MD): Agency for Health Care Policy and Research; 1997. MEPS Methodology Report No. 2. AHRQ Pub. No. 97-0027.

Cohen S. Sample design of the 1997 Medical Expenditure Panel Survey Household Component. Rockville (MD): Agency for Healthcare Research and Quality; 2000. MEPS Methodology Report No. 11. AHRQ Pub. No. 01-0001.

Finkelstein JA, Stille C, Nordin J, et al. Reduction in antibiotic use among US children, 1996-2000. Pediatrics 2003 Sep; 112(3 Pt 1): 620-7.

Mainous AG III, Hueston WJ, Davis MP, et al. Trends in antimicrobial prescribing for bronchitis and upper respiratory infections among adults and children. Am J Public Health 2003 Nov; 93(11):1910-4.

McCaig LF, Besser RE, Hughes JM. Trends in antimicrobial prescribing rates for children and adolescents. JAMA 2002 Jun 19; 287(23):3096-102.

Moeller JF, Stagnitti MN, Horan E, et al. Outpatient prescription drugs: data collection and editing in the 1996 Medical Expenditure Panel Survey (HC-010A). Rockville (MD): Agency for Healthcare Research and Quality; 2001. MEPS Methodology Report No. 12. AHRQ Pub. No. 01-0002.

Perz JF, Craig AS, Coffey CS, et al. Changes in antibiotic prescribing for children after a community-wide campaign. JAMA 2002; 287:3101-9.

Steinman MA, Gonzales R, Linder JA, et al. Changing use of antibiotics in community-based outpatient practice, 1991-1999. Ann Intern Med 2003 Apr; 138(7):525-33.

Table 1. Antibiotic use by children age 14 years and under: United States, 1996 to 2001

Statistic	1996	1997	1998	1999	2000	2001
	Number in millions					
Population size[a]	59.2	59.8	59.8	61.0	60.6	60.6
	Percent					
Percent of children with any antibiotic use	39.0	33.7	30.6	28.9	28.6	29.0
	Number					
Average number of antibiotic prescriptions:						
All children	0.9	0.7	0.6	0.6	0.5	0.5
Children with any antibiotic use	2.4	2.1	1.9	2.0	1.9	1.9

[a] Age is recorded at the end of the year.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-2001.

Table 2. Antibiotic use by children age 14 years and under: Use by selected population characteristics, United States, 1996-97 and 2000-01

Population characteristic	1996-97 annualized estimates of use				2000-01 annualized estimates of use			
			Antibiotic use				Antibiotic use	
	Total population in millions	Ambulatory visit[a]	Overall	With ambulatory visit	Total population in millions	Ambulatory visit[a]	Overall	With ambulatory visit
			Percent				Percent	
Total	59.5	75.3	36.3	46.5	60.6	74.1	28.8	37.7
Age in years[b]								
4 and under	19.7	85.8	46.0	52.6	19.8	85.3	37.5	43.3
5-9	20.3	73.7	37.6	48.8	20.1	70.3	29.6	40.4
10-14	19.5	66.4	25.2	35.9	20.7	67.2	19.8	28.1
Race/ethnicity								
Hispanic	9.2	67.2	29.3	41.5	10.6	68.3	24.1	34.0
Black	9.3	63.9	20.6	30.5	9.5	63.2	15.6	23.2
White and other[c]	41.0	79.7	41.5	50.3	40.5	78.2	33.2	41.3
Sex								
Male	30.4	75.8	35.9	45.8	31.0	74.3	28.3	37.1
Female	29.1	74.8	36.8	47.2	29.7	74.0	29.4	38.3
Income[d]								
Poor or near poor	15.9	68.6	29.3	41.1	13.9	67.0	21.5	30.9
Low income	10.0	68.3	29.8	41.0	9.8	68.8	25.0	34.5
Middle income	20.0	77.6	39.8	49.4	19.9	74.7	31.0	40.3
High income	13.5	85.0	44.4	50.9	17.0	82.3	34.5	40.9
Health insurance status								
Any private[e]	40.1	79.0	40.4	49.3	40.9	77.1	32.0	40.2
Public only	13.3	71.9	29.9	40.2	14.6	72.8	24.0	32.1
Uninsured	6.1	58.3	23.8	37.8	5.1	54.3	17.8	31.3

Continued

Table 2. Antibiotic use by children age 14 years and under: Use by selected population characteristics, United States, 1996-97 and 2000-01 *(continued)*

Population characteristic	1996-97 annualized estimates of use				2000-01 annualized estimates of use			
	Total population in millions	Ambulatory visit[a]	Antibiotic use		Total population in millions	Ambulatory visit[a]	Antibiotic use	
			Overall	With ambulatory visit			Overall	With ambulatory visit
			Percent				Percent	
Perceived health status[f]								
Excellent or very good	47.4	74.5	34.6	44.5	49.6	73.1	27.7	36.7
Good	9.4	77.5	42.2	53.1	9.4	76.5	32.1	40.7
Fair or poor	2.2	89.5	56.0	62.0	1.6	91.9	43.5	47.1
Metropolitan statistical area (MSA)[f]								
MSA	47.9	75.7	35.6	45.5	50.2	74.1	27.8	36.5
Non-MSA	11.5	73.8	39.4	50.8	10.4	74.5	33.7	43.5
Census region								
Northeast	10.8	79.9	34.0	40.9	10.7	81.2	29.3	35.2
Midwest	14.0	79.7	40.4	49.2	13.7	76.1	31.4	40.3
South	20.4	72.9	36.9	48.8	21.2	71.8	28.7	38.2
West	14.3	71.0	33.3	44.7	15.0	70.5	26.5	36.5

a Includes visits to an office-based medical provider, emergency room, or hospital outpatient department.

b Age is recorded at the end of the year.

c Includes all other racial/ethnic groups not shown separately.

d Poor or near poor refers to persons living in families with income of 125 percent of the Federal poverty line or less; low income, over 125 percent through 200 percent of the poverty line; middle income, over 200 percent through 400 percent of the poverty line; and high income, over 400 percent of the poverty line.

e Includes children with private and public coverage.

f Data on this variable were not available for all sample persons.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-97 and 2000-01.

Table 3. Antibiotic use by children age 14 years and under: Average number of antibiotic prescriptions by selected population characteristics, United States, 1996-97 and 2000-01

Population characteristic	1996-97 annualized estimates of antibiotic use			2000-01 annualized estimates of antibiotic use		
	Total prescriptions in millions	Average number of prescriptions		Total prescriptions in millions	Average number of prescriptions	
		Overall	With use		Overall	With use
Total	48.9	0.8	2.3	32.9	0.5	1.9
Age in years[a]						
4 and under	24.3	1.2	2.7	15.4	0.8	2.1
5-9	15.7	0.8	2.1	10.8	0.5	1.8
10-14	8.9	0.5	1.8	6.7	0.3	1.6
Race/ethnicity						
Hispanic	5.5	0.6	2.1	4.8	0.4	1.9
Black	3.5	0.4	1.8	2.5	0.3	1.7
White and other[b]	39.8	1.0	2.3	25.7	0.6	1.9
Sex						
Male	25.5	0.8	2.3	16.7	0.5	1.9
Female	23.4	0.8	2.2	16.2	0.5	1.9
Income[c]						
Poor or near poor	8.9	0.6	1.9	4.9	0.4	1.7
Low income	6.0	0.6	2.0	4.4	0.4	1.8
Middle income	19.6	1.0	2.5	12.1	0.6	2.0
High income	14.3	1.1	2.4	11.5	0.7	1.9
Health insurance status						
Any private[d]	38.5	1.0	2.4	25.0	0.6	1.9
Public only	7.8	0.6	2.0	6.3	0.4	1.8
Uninsured	2.6	0.4	1.8	1.6	0.3	1.8
Perceived health status[e]						
Excellent or very good	33.9	0.7	2.1	24.6	0.5	1.8
Good	10.8	1.2	2.7	6.1	0.6	2.0
Fair or poor	4.2	1.9	3.4	2.2	1.4	3.1
Metropolitan statistical area (MSA)[e]						
MSA	38.7	0.8	2.3	26.2	0.5	1.9
Non-MSA	10.2	0.9	2.3	6.7	0.6	1.9
Census region						
Northeast	8.3	0.8	2.3	5.7	0.5	1.8
Midwest	12.8	0.9	2.3	8.6	0.6	2.0
South	17.4	0.9	2.3	11.9	0.6	2.0
West	10.4	0.7	2.2	6.7	0.4	1.7

[a] Age is recorded at the end of the year.

[b] Includes all other racial/ethnic groups not shown separately.

[c] Poor or near poor refers to persons living in families with income of 125 percent of the Federal poverty line or less; low income, over 125 percent through 200 percent of the poverty line; middle income, over 200 percent through 400 percent of the poverty line; and high income, over 400 percent of the poverty line.

[d] Includes children with private and public coverage.

[e] Data on this variable were not available for all sample persons.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-97 and 2000-01.

Table 4. Antibiotic use for otitis media by children age 14 years and under: Summary statistics, United States, 1996 to 2001

Statistic	1996	1997	1998	1999	2000	2001
	Number in millions					
Population size[a]	59.2	59.8	59.8	61.0	60.6	60.6
Otitis media (OM):[b]	Percent					
Percent reported to have OM	21.1	19.1	17.0	15.3	15.4	16.4
Percent with an ambulatory care visit[c] for OM	15.1	13.7	14.4	12.9	12.5	12.7
Percent prescribed an antibiotic for OM	14.4	12.6	12.6	11.0	10.9	11.5
Percent prescribed an antibiotic given an ambulatory care visit for OM	82.8	78.3	78.2	75.9	76.7	79.0
	Number					
Average number of antibiotic prescriptions for OM given use	2.23	2.00	1.72	1.79	1.84	1.81

[a] Age is recorded at the end of the year.

[b] Includes conditions with an ICD-9 code of 381 or 382 (International Classification of Diseases, 9th Revision).

[c] Includes visits to an office-based medical provider, emergency room, or hospital outpatient department.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-2001.

Table 5. Antibiotic use for otitis media by children age 14 years and under: Use by selected population characteristics, United States, 1996 to 2001

Population characteristic	Average number of children reported to have otitis media in millions	1996 to 2001 annualized estimates			
		Ambulatory visit[a]	Antibiotic use		Average prescriptions given use
			Overall	With ambulatory visit	
		Percent			
Total	10.4	78.1	70.0	78.6	1.9
Age in years[b]					
4 and under	6.3	78.0	73.2	81.9	2.1
5-9	2.9	78.4	66.4	75.5	1.6
10-14	1.3	77.8	62.5	69.5	1.4
Race/ethnicity					
Hispanic	1.3	74.1	64.9	74.2	1.8
Black	0.9	70.7	61.9	70.7	1.6
White and other[c]	8.2	79.5	71.7	80.0	2.0
Sex					
Male	5.4	78.8	69.1	77.3	2.0
Female	5.0	77.3	71.0	79.9	1.8
Income[d]					
Poor or near poor	2.0	75.5	64.5	73.6	1.6
Low income	1.5	75.8	67.2	76.0	1.8
Middle income	3.6	77.8	70.5	79.2	2.0
High income	3.3	81.0	74.1	81.9	2.0
Health insurance status					
Any private[e]	7.8	79.7	72.2	80.2	2.0
Public only	2.0	74.3	65.3	74.3	1.7
Uninsured	0.6	69.0	57.1	68.7	1.6
Perceived health status[f]					
Excellent or very good	8.0	77.7	70.3	79.2	1.8
Good	1.9	79.8	68.5	75.9	2.1
Fair or poor	0.5	81.4	73.9	79.3	2.7
Metropolitan statistical area (MSA)[f]					
MSA	8.4	77.3	69.8	78.9	1.9
Non-MSA	2.1	81.1	70.6	77.2	2.0
Census region					
Northeast	2.0	77.6	70.4	78.4	1.9
Midwest	2.6	80.1	74.6	82.5	2.0
South	3.4	77.4	67.7	76.9	2.0
West	2.4	77.3	68.1	76.7	1.8

[a] Includes visits to an office-based medical provider, emergency room, or hospital outpatient department.

[b] Age is recorded at the end of the year.

[c] Includes all other racial/ethnic groups not shown separately.

[d] Poor or near poor refers to persons living in families with income of 125 percent of the Federal poverty line or less; low income, over 125 percent through 200 percent of the poverty line; middle income, over 200 percent through 400 percent of the poverty line; and high income, over 400 percent of the poverty line.

[e] Includes children with private and public coverage.

[f] Data on this variable were not available for all sample persons.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-2001.

Technical Appendix

The data used in this report were obtained from interviews conducted as part of the Household Component of the Medical Expenditure Panel Survey (MEPS) for 1996-2001. MEPS is an ongoing, annual survey of the civilian noninstitutionalized population. MEPS collects detailed information on health care use and expenditures (including sources of payment); health insurance; and health status, access, and quality. It also collects detailed demographic and economic information on the persons and households surveyed. More information about MEPS can be found at http://www.meps.ahrq.gov. For a detailed description of the survey and its methodology, also see J. Cohen (1997) and S. Cohen (1997, 2000).

Survey Design

Each year, the MEPS sample is drawn from households that completed the prior year's National Health Interview Survey (NHIS). Households selected for participation in the 1996 MEPS completed interviews in the 1995 NHIS, the 1997 MEPS sample was drawn from the 1996 NHIS, and so on. Because NHIS is used as a sampling frame, the MEPS design is not only nationally representative of the civilian noninstitutionalized population but also includes an oversampling of Hispanics and blacks.

MEPS collects data in an overlapping panel design. Each household completes five interviews ("rounds" of data collection) over a period of $2^1/_2$ years, providing data for two full calendar years of estimates. Data from Rounds 1, 2, and 3 provide information for the first year of estimation, and data from Rounds 3, 4, and 5 provide data for the second year of estimates. For example, estimates for 2001 are derived by combining Rounds 3, 4, and 5 of the 2000 panel and Rounds 1, 2, and 3 of the 2001 panel. An exception is 1996, when the MEPS longitudinal data collection was initiated. For that year, a single panel's data were used for estimation. In MEPS, a single respondent provides most of the information to an interviewer using computer-assisted personal interviewing (CAPI). In addition to the CAPI interview, beginning in 2000, limited data have been collected using a self-administered questionnaire (SAQ).

Definitions

Antibiotics. The definition of antibiotics includes all major classes of oral antibiotics but excludes topical antibiotics.

Ambulatory care visits. This category includes visits to medical providers seen in office-based settings or clinics, hospital outpatient departments, and emergency rooms. It also includes phone contacts with providers in office-based settings.

Age. In this report, age is the last available age for the sampled person.

Race/ethnicity. Classification by race and ethnicity was based on information provided by the household respondent for each household member. The respondent was asked if each person's race was best described as black, white, Asian or Pacific Islander, American Indian, or Alaska Native. The respondent was also asked if each person's main national origin or ancestry was Puerto Rican, Cuban, Mexican, Mexicano, Mexican American, or Chicano; other Latin American; or other Spanish. Persons claiming a main national origin or ancestry in one of these Hispanic groups, regardless of racial background, were classified as Hispanic. Since the Hispanic grouping can include persons of any race, the race categories of black and white/other exclude Hispanics.

Income. Each year, persons were classified according to their family's income in terms of poverty status. In this report, poverty status is the ratio of the family's income to the Federal poverty thresholds, which control for the size of the family and the age of the head of the family. In this report, the following classification of poverty status was used.

- *Poor or near poor*: Persons in families with income of 125 percent of the poverty line or less, including those who reported negative income.
- *Low income*: Persons in families with income from over 125 percent through 200 percent of the poverty line.
- *Middle income*: Persons in families with income from over 200 percent through 400 percent of the poverty line.
- *High income*: Persons in families with income over 400 percent of the poverty line.

In MEPS, personal income from all household members is summed to create family income. Potential income sources asked about in the survey interview

include annual earnings from wages, salaries, bonuses, tips, and commissions; business and farm gains and losses; unemployment and Workers' Compensation payments; interest and dividends; alimony, child support, and other private cash transfers; private pensions; individual retirement account (IRA) withdrawals; Social Security and Department of Veterans Affairs payments; Supplemental Security Income and cash welfare payments from public assistance, TANF (Temporary Assistance for Needy Families; formerly known as Aid to Families with Dependent Children, or AFDC); gains or losses from estates, trusts, partnerships, S corporations, rent, and royalties; and a small amount of "other" income.

Health insurance status. Respondents were asked about health insurance coverage for themselves and all household members at each round of interviewing. The insurance variables reflect coverage for hospital and physician services. Persons categorized as having insurance coverage may or may not have coverage for prescription drugs.

- ` *Any private insurance.* This group includes those who, at any time in the survey year, had individual or group plan coverage for medical or related expenses, including prepaid health plans such as health maintenance organizations but excluding extra cash coverage plans, medical benefits linked only to specific diseases (dread disease plans), and casualty benefit plans (such as automobile insurance).
- *Public insurance only.* This group includes persons who were never covered by private insurance during the year but who were covered at any time by Medicare, TRICARE (which covers retired members of the uniformed services and the spouses and children of active-duty military), Medicaid, and other State and local medical assistance programs.
- *Uninsured.* This group comprises all persons with neither public nor private insurance coverage throughout the calendar year.

Perceived health status. During each round of interviewing, the household respondent was asked to rate the health of each person in the family according to the following categories: excellent, very good, good, fair, or poor. For this report, the response categories "excellent" and "very good" were collapsed, as were "fair' and "poor." Also, for this report, each person's

health status was determined using the worst reported health status during the year.

MSA. Individuals were identified as residing either inside or outside a metropolitan statistical area (MSA) as designated by the U.S. Office of Management and Budget, which applied 1990 standards using population counts from the 1990 U.S. census. An MSA is a large population nucleus combined with adjacent communities that have a high degree of economic and social integration with the nucleus. Each MSA has one or more central counties containing the area's main population concentration. In New England, metropolitan areas consist of cities and towns rather than whole counties.

Census region. Each MEPS sampled person was classified as living in one of the following four regions as defined by the U.S. Census Bureau.
- Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.
- Midwest: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, South Dakota, North Dakota, Nebraska, and Kansas.
- South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.
- West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii.

Sample Design and Accuracy of Estimates

The statistics presented in this report are affected by both sampling error and sources of nonsampling error, which include nonresponse bias, respondent reporting errors, interviewer effects, and data processing misspecifications. The MEPS person-level estimation weights include nonresponse adjustments and poststratification adjustments to population estimates derived from the Current Population Survey based on cross-classifications by region, MSA, age, race/ethnicity, and sex. The overall MEPS response rate reflects response to both the MEPS and NHIS interviews. The sample size and annual response rates are:

Calendar year	Sample size	Pooled annual response rate
1996	21,571	70.2
1997	32,636	66.4
1998	22,953	67.9
1999	23,565	64.3
2000	23,839	65.3
2001	32,122	66.3

Rounding

Because of rounding and some missing data, some of the subpopulation estimates presented in the tables will not sum exactly to the overall population total. Standard errors are presented in Tables A-E.

Standard Error Tables

Table A. Standard errors for antibiotic use by children age 14 years and under: Summary statistics, United States, 1996 to 2001

Corresponds to Table 1

Statistic	1996	1997	1998	1999	2000	2001
			Standard error			
Population size[a]	1.72	1.39	1.80	2.00	2.66	1.58
Percent of children with any antibiotic use	0.93	0.78	0.84	0.95	0.85	0.77
Average number of antibiotic prescriptions:						
All children	0.04	0.02	0.02	0.03	0.02	0.02
Children with any antibiotic use	0.07	0.05	0.05	0.06	0.05	0.04

[a] Age is recorded at the end of the year.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-2001.

Table B. Standard errors for antibiotic use by children age 14 years and under: Use by selected population characteristics, United States, 1996-97 and 2000-01

Corresponds to Table 2

Population characteristic	1996-97 annualized estimates of use				2000-01 annualized estimates of use			
	Total population in millions	Ambulatory visit[a]	Antibiotic use		Total population in millions	Ambulatory visit[a]	Antibiotic use	
			Overall	With ambulatory visit			Overall	With ambulatory visit
	Standard error							
Total	1.58	0.58	0.61	0.71	1.97	0.62	0.57	0.74
Age in years[b]								
4 and under	0.62	0.73	1.02	1.10	0.78	0.76	1.00	1.16
5-9	0.65	0.83	0.99	1.16	0.67	0.91	0.95	1.28
10-14	0.60	1.02	0.87	1.13	0.74	0.89	0.69	0.94
Race/ethnicity								
Hispanic	0.41	1.14	1.20	1.48	0.52	1.21	1.04	1.36
Black	0.52	1.39	1.09	1.60	0.58	1.43	0.96	1.37
White and other[c]	1.27	0.66	0.80	0.90	1.58	0.76	0.74	0.89
Sex								
Male	0.86	0.73	0.79	0.95	1.02	0.80	0.74	0.96
Female	0.83	0.74	0.85	0.98	1.03	0.76	0.72	0.91
Income[d]								
Poor or near poor	0.64	1.04	1.08	1.36	0.62	1.28	1.07	1.41
Low income	0.47	1.25	1.19	1.51	0.43	1.50	1.19	1.48
Middle income	0.69	0.90	1.06	1.20	0.84	0.95	1.01	1.19
High income	0.57	0.92	1.33	1.45	0.78	0.97	1.24	1.40
Health insurance status								
Any private[e]	1.20	0.70	0.77	0.88	1.49	0.69	0.74	0.85
Public only	0.55	1.06	1.12	1.35	0.62	1.16	1.08	1.37
Uninsured	0.30	1.73	1.49	2.15	0.31	1.87	1.34	2.18
Perceived health status[f]								
Excellent or very good	1.29	0.65	0.67	0.79	1.63	0.69	0.61	0.78
Good	0.38	1.23	1.41	1.58	0.45	1.29	1.29	1.56
Fair or poor	0.12	1.62	2.65	2.71	0.13	1.44	3.26	3.48

Table B. Standard errors for antibiotic use by children age 14 years and under: Use by selected population characteristics, United States, 1996-97 and 2000-01 *(continued)*

Corresponds to Table 2

Population characteristic	1996-97 annualized estimates of use				2000-01 annualized estimates of use			
	Total population in millions	Ambulatory visit[a]	Antibiotic use		Total population in millions	Ambulatory visit[a]	Antibiotic use	
			Overall	With ambulatory visit			Overall	With ambulatory visit
	Standard error							
Metropolitan statistical area (MSA)[f]								
MSA	1.42	0.65	0.70	0.82	1.84	0.70	0.64	0.84
Non-MSA	0.70	1.31	1.38	1.59	0.61	1.05	1.20	1.51
Census region								
Northeast	0.58	1.31	1.40	1.62	0.54	1.50	1.37	1.58
Midwest	0.76	0.89	1.38	1.62	0.94	1.20	1.01	1.21
South	1.08	1.04	1.08	1.21	1.18	1.00	1.05	1.27
West	0.65	1.23	1.10	1.41	1.10	1.19	1.17	1.79

[a] Includes visits to an office-based medical provider, emergency room, or hospital outpatient department.
[b] Age is recorded at the end of the year.
[c] Includes all other racial/ethnic groups not shown separately.
[d] Poor or near poor refers to persons living in families with income of 125 percent of the Federal poverty line or less; low income, over 125 percent through 200 percent of the poverty line; middle income, over 200 percent through 400 percent of the poverty line; and high income, over 400 percent of the poverty line.
[e] Includes children with private and public coverage.
[f] Data on this variable were not available for all sample persons.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-97 and 2000-01.

Table C. Standard errors for antibiotic use by children age 14 years and under: Average number of antibiotic prescriptions by selected population characteristics, United States, 1996-97 and 2000-01.

Corresponds to Table 3

Population characteristic	1996-97 annualized estimates of antibiotic use			2000-01 annualized estimates of antibiotic use		
	Total prescriptions in millions	Average number of prescriptions Overall	With use	Total prescriptions in millions	Average number of prescriptions Overall	With use
			Standard error			
Total	1.99	0.02	0.04	1.48	0.02	0.03
Age in years[a]						
4 and under	1.27	0.05	0.09	0.91	0.03	0.05
5-9	0.80	0.03	0.06	0.63	0.02	0.05
10-14	0.61	0.03	0.08	0.37	0.01	0.05
Race/ethnicity						
Hispanic	0.41	0.03	0.07	0.42	0.03	0.09
Black	0.39	0.03	0.12	0.23	0.02	0.08
White and other[b]	1.83	0.03	0.05	1.34	0.02	0.04
Sex						
Male	1.25	0.03	0.06	0.90	0.02	0.05
Female	1.12	0.03	0.06	0.74	0.02	0.04
Income[c]						
Poor or near poor	0.56	0.03	0.06	0.39	0.02	0.06
Low income	0.47	0.04	0.10	0.37	0.03	0.09
Middle income	1.21	0.04	0.08	0.79	0.03	0.06
High income	0.98	0.06	0.10	0.76	0.03	0.05
Health insurance status						
Any private[d]	1.88	0.03	0.06	1.23	0.02	0.04
Public only	0.50	0.03	0.06	0.50	0.03	0.07
Uninsured	0.27	0.04	0.11	0.16	0.03	0.10
Perceived health status[e]						
Excellent or very good	1.45	0.02	0.05	1.13	0.02	0.03
Good	0.74	0.06	0.12	0.44	0.04	0.08
Fair or poor	0.43	0.16	0.22	0.31	0.16	0.27
Metropolitan statistical area (MSA)[e]						
MSA	1.81	0.03	0.05	1.33	0.02	0.04
Non-MSA	0.80	0.05	0.09	0.59	0.03	0.06
Census region						
Northeast	0.81	0.05	0.11	0.43	0.03	0.08
Midwest	1.01	0.05	0.07	0.69	0.03	0.05
South	1.28	0.04	0.09	0.87	0.03	0.07
West	0.74	0.04	0.09	0.78	0.03	0.05

[a] Age is recorded at the end of the year.

[b] Includes all other racial/ethnic groups not shown separately.

[c] Poor or near poor refers to persons living in families with income of 125 percent of the Federal poverty line or less; low income, over 125 percent through 200 percent of the poverty line; middle income, over 200 percent through 400 percent of the poverty line; and high income, over 400 percent of the poverty line.

[d] Includes children with private and public coverage.

[e] Data on this variable were not available for all sample persons.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-97 and 2000-01.

Table D. Standard errors for antibiotic use for otitis media by children age 14 years and under: Summary statistics, United States, 1996 to 2001

Corresponds to Table 4

Statistic	1996	1997	1998	1999	2000	2001
	Standard error					
Population size)a	1.72	1.39	1.80	2.00	2.66	1.58
Otitis media (OM):b						
Percent reported to have OM	0.76	0.65	0.73	0.75	0.62	0.60
Percent with an ambulatory care visitc for OM	0.63	0.54	0.69	0.72	0.58	0.52
Percent prescribed an antibiotic for OM	0.63	0.51	0.60	0.64	0.56	0.50
Percent prescribed an antibiotic given an ambulatory care visit for OM	1.88	1.56	1.76	2.33	1.97	1.63
Average number of antibiotic prescriptions for OM given use	0.10	0.08	0.06	0.07	0.08	0.07

a Age is recorded at the end of the year.

b Includes conditions with an ICD-9 code of 381 or 382 (International Classification of Diseases, 9th Revision).

c Includes visits to an office-based medical provider, emergency room, or hospital outpatient department.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-2001.

Table E. Standard errors for antibiotic use for otitis media by children age 14 years and under: Use by selected population characteristics, United States, 1996 to 2001

Corresponds to Table 5

Population characteristic	1996 to 2001 annualized estimates				
	Average number of children reported to have otitis media in millions	Ambulatory visit[a]	Antibiotic use		Average prescriptions given use
			Overall	With ambulatory visit	
			Standard error		
Total	0.35	0.65	0.76	0.76	0.03
Age in years[b]					
4 and under	0.23	0.91	0.91	0.89	0.05
5-9	0.12	1.20	1.42	1.48	0.04
10-14	0.07	1.68	2.39	2.58	0.05
Race/ethnicity					
Hispanic	0.07	1.46	1.46	1.47	0.08
Black	0.06	2.34	2.41	2.57	0.07
White and other[c]	0.31	0.73	0.88	0.88	0.04
Sex					
Male	0.21	0.92	1.00	1.03	0.05
Female	0.19	0.91	1.06	1.07	0.04
Income[d]					
Poor or near poor	0.10	1.44	1.56	1.71	0.04
Low income	0.08	1.69	1.95	2.01	0.07
Middle income	0.16	1.10	1.31	1.31	0.06
High income	0.14	1.33	1.36	1.36	0.07
Health insurance status					
Any private[e]	0.28	0.75	0.87	0.86	0.04
Public only	0.10	1.41	1.60	1.72	0.05
Uninsured	0.05	2.89	2.96	3.38	0.10
Perceived health status[f]					
Excellent or very good	0.28	0.75	0.86	0.84	0.03
Good	0.09	1.44	1.64	1.71	0.09
Fair or poor	0.04	2.40	3.15	3.07	0.18
Metropolitan statistical area (MSA)[f]					
MSA	0.29	0.76	0.85	0.84	0.04
Non-MSA	0.13	1.40	1.61	1.71	0.07
Census region					
Northeast	0.12	1.59	1.83	1.90	0.08
Midwest	0.16	1.35	1.51	1.34	0.06
South	0.18	1.22	1.32	1.34	0.06
West	0.16	1.38	1.42	1.51	0.06

[a] Includes visits to an office-based medical provider, emergency room, or hospital outpatient department.

[b] Age is recorded at the end of the year.

[c] Includes all other racial/ethnic groups not shown separately.

[d] Poor or near poor refers to persons living in families with income of 125 percent of the Federal poverty line or less; low income, over 125 percent through 200 percent of the poverty line; middle income, over 200 percent through 400 percent of the poverty line; and high income, over 400 percent of the poverty line.

[e] Includes children with private and public coverage.

[f] Data on this variable were not available for all sample persons.

Note: Does not include topical antibiotics.

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 1996-2001.