

# Direct Expenditures Related to Otitis Media Diagnoses: Extrapolations From a Pediatric Medicaid Cohort

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**ABSTRACT.** *Background.* Treatment of otitis media in children is associated with substantial expenditures because of its high frequency during childhood. Vaccines against respiratory pathogens causing otitis media are now being developed. Information about otitis media-related medical expenditures will be needed to determine the cost-effectiveness of these preventive interventions.

*Methods.* This study used utilization data from claims to impute otitis media-related expenditures for medical visits, pharmaceuticals, and surgical procedures for 87 057 children 13 years of age and younger who were continuously enrolled in Colorado's fee-for-service Medicaid program during 1992. *International Classification of Disease, Ninth Revision* diagnostic codes were used to identify visits for otitis media. An antibiotic was considered to have been prescribed to treat otitis media if it was dispensed up to 24 hours before or within 48 hours after a physician encounter showing a diagnosis of otitis media. All tympanostomies, mastoidectomies, and adenoidectomies were assumed to be related to otitis media. Expenditures were imputed from utilization using a Medicaid fee schedule.

National expenditures for 1992 to treat otitis media were extrapolated from Colorado's Medicaid data. We adjusted for differences between Colorado and the United States as a whole in terms of price, number, and intensity of services; for differences in reimbursement rates by service between Medicaid and private insurance; and for differences in utilization between Medicaid enrollees and the uninsured. To provide a more current expression of medical expenditures for otitis media, we inflated the 1992 expenditure estimates to 1998 dollars using the Consumer Price Index published by the US Bureau of Labor Statistics.

*Results.* Twenty-eight percent of children experienced at least 1 episode of diagnosed otitis media. The proportion of children with a diagnosis of otitis media was highest (42%–60%) in the 7-month to 36-month age range. The proportion was also higher among white (34.5%) and Hispanic (25.3%) children than among black children (18.5%), as well as among rural (34.5%) compared with urban children (27.2%).

Children 19 to 24 months of age incurred the highest total annual expenditures per child with otitis media (\$239.68). Expenditures for drugs, visits, and procedures were all highest for this group. The per-patient cost to Medicaid was greater for visits than for drugs or procedures across all age groups.

Total per-patient expenditures were higher for males (\$174.67) than for females (\$154.47) and higher for white children (\$176.59) than for Hispanic (\$154.12) or black children (\$134.44). The differences among the ethnic groups can be attributed almost entirely to differences in expenditures for procedures and drugs. Although mean expenditures per patient varied substantially by some patient characteristics (eg, race), these differences accounted for only a small fraction of the enormous variation in costs per patient.

Including children with and without otitis media, age-specific estimated expenditures per child peaked among children 1 (\$132.94) and 2 years of age (\$88.72). Children 3 to 6 years of age incurred expenditures only one third as great as those incurred by children 1 year of age.

Total national expenditures were estimated to have been approximately \$4.1 billion in 1992 dollars and \$5.3 billion in 1998 dollars. Over 40% of national expenditures to treat otitis media in children younger than 14 years of age were incurred for children between 1 and 3 years of age (\$453 per capita in 1992 dollars over these 2 years vs \$1027 for all years of age from 2 to 13). Nationally, expenditures for visits remained the largest component of expenditures.

*Limitations.* This study assessed expenditures from the point of view of the health care system; that is, no social costs, such as lost work time, or expenditures not normally covered by insurance, such as those for transportation, were included. The study captured expenditures to treat otitis media during a calendar year and should not be interpreted as the cost to treat episodes of otitis media. Our reported expenditures may have captured only part of an episode straddling 2 calendar years, or, alternatively, they may cover several episodes.

The figures reporting 1992 expenditures expressed in 1998 dollars should not be taken as an estimate of 1998 expenditures to treat otitis media. The approach used to adjust the expenditures did not take into account changes in the medical practice environment, such as would occur with a movement of the population from predominantly fee-for-service practice to managed care or the introduction of new treatment practices. It also did not account for changes in insurance status, eg, an increase in the proportion of uninsured children, or for population increases.

Most importantly, our estimates of expenditures are based on treatment of otitis media as it was practiced in 1992, before the current practice guidelines were promulgated. The effect of the guidelines on physician practice in 1992 may, however, not have been substantial. In 1998, Christakis and Rivara found that only 50% of pediatricians were aware of the otitis media guidelines, and of these, only 28% believed that they had changed their practice as a result of the guidelines. It is important to remember that our estimates are based on 1992 Medicaid utilization. Given Medicaid's low reimbursement to primary care physicians at that time, doctors would have

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had little financial incentive to see patients more often than necessary. Thus, insofar as practice guidelines encouraged fewer visits, Medicaid utilization may already reflect close adherence to the practice guidelines.

**Conclusions.** Because 40% of expenditures to treat otitis media are incurred between 1 and 3 years of age, vaccines designed to reduce the incidence of otitis media are most likely to be cost-effective if they can be administered before the child's first birthday.

Because visits are the most costly category of service for all payers, otitis media case management guidelines should emphasize reducing unnecessary visits, for instance, by improving physician training in pneumatic otoscopy, which has been shown to be critical to an accurate diagnosis of otitis media, and by scheduling follow-up visits for children who have become asymptomatic 3 to 4 weeks after diagnosis rather than after 10 to 14 days, allowing time for resolution of the middle ear effusion. *Pediatrics* 2000;105(6). URL: <http://www.pediatrics.org/cgi/content/full/105/6/e72>; *otitis media, expenditures*.

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ABBREVIATIONS. MMED, Medicaid Medical Events Database; ICD-9, *International Classification of Disease, Ninth Revision*.

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The medical and surgical treatment of otitis media in children is associated with substantial expenditures because of the high frequency of this condition during childhood. Vaccines against a broad array of viral and bacterial respiratory pathogens causing otitis media, such as respiratory syncytial virus and *Streptococcus pneumoniae*, are now being developed and introduced into clinical practice. Information about otitis media-related medical expenditures—including expenditures for physician visits, antibiotics, and surgical procedures—will be needed to determine the cost-effectiveness of these preventive interventions. The principal barrier to obtaining this information has been the limited availability to researchers of large databases that link diagnoses with outpatient and emergency department visits, antibiotic and other drug prescription fills, and surgical procedures. We overcame this barrier by using Colorado's Medicaid database, which links such data for individual patients and allows longitudinal analysis that can adjust for enrollment periods. This study used utilization data to impute otitis media-related expenditures for medical visits, pharmaceuticals, and surgical procedures for children 13 years of age and younger enrolled in the Colorado Medicaid program during 1992. We then estimated national otitis media-related expenditures for all children 13 years of age and younger according to their age and insurance status.

## METHODS

### Study Population

The study population consisted of 87 057 children who were 13 years of age and younger at the end of 1992 and were continuously enrolled in Colorado's fee-for-service Medicaid program during 1992. Children were deemed continuously enrolled if they either were enrolled for all of the study year or were born during the study year and enrolled from birth to the end of the study year. Colorado Medicaid eligibility during this period conformed with federal requirements. During the period of the study, >95% of the

state's Medicaid recipients obtained services in a fee-for-service environment.

### Estimating Medicaid Expenditures

Data were obtained from the Medicaid Medical Events Database (MMED), which is an extract of Colorado's Medicaid Management Information System. Data included patient demographic information, provider information, and claims paid by Medicaid for prescriptions, outpatient office and clinic visits, emergency department visits, surgical procedures, and inpatient hospitalizations. A detailed description of MMED and the artificial intelligence software developed by the research team is available in previous publications.<sup>1,2</sup> The analyses followed individual patients over time using their unique Medicaid recipient identification numbers, which are maintained across interrupted periods of enrollment, name changes, and moves to different counties.

*International Classification of Disease, Ninth Revision* (ICD-9) diagnostic codes were used to identify visits for otitis media. We made no attempt to use these codes to distinguish otitis media with effusion from acute otitis designations because we wanted to determine the costs associated with both conditions and because physicians' coding practices have been found to be sufficiently variable to render such distinctions invalid.<sup>3</sup> Thus, we aggregated otitis diagnostic codes to the third ICD-9 digit. The site of a visit for otitis media (a hospital emergency department, specialist, or primary care physician) was determined using the *Current Procedural Terminology* code and place-of-service variables in MMED. An antibiotic was considered to have been prescribed to treat otitis media if it was dispensed up to 24 hours before or within 48 hours after a physician encounter showing a diagnosis of otitis media.<sup>4</sup> All tympanostomies, mastoidectomies, and adenoidectomies were assumed to be related to otitis media.

The patient demographic variables included age, sex, urban/rural residence, ethnicity, and Medicaid eligibility category. Ages reflect the child's age at the end of the study year. Residence referred to the first county of residence during the study year, with urban defined by the Census Bureau's metropolitan statistical areas. The classification for ethnicity included white, Hispanic, black, Native American, and other.

We documented the utilization of medical visits, pharmaceuticals, and surgical procedures for otitis media during the 1992 calendar year and, using a Medicaid fee schedule, calculated the associated expenditures. Such calculation was necessary because the database to which we had access had no direct linkage to reimbursement information. We imputed expenditures for antibiotics using the type of antibiotic and age of the child, since the actual cost to Medicaid for any antibiotic was not included in the MMED database.<sup>5</sup> Prices were based on the average wholesale price or federal maximum allowable cost of a 10-day course of the drug for children at the 95th percentile of body weight for each age group. For some age categories, more than 1 formulation of a drug was appropriate (eg, a pill and a liquid). In this case, the lowest-cost formulation was used to impute costs. Visits were categorized according to site (primary care, specialist, or emergency department) and intensity as shown in Table 1. Because each category comprised many *Current Procedural Terminology* codes, which were reimbursed at different rates, we used the mean reimbursement per category to impute costs. For emergency department visits, we also added a facility fee of \$85.51. Table 1 shows the values used for imputing reimbursement for both visits and surgeries related to otitis media. The figures for surgical procedures are based on Medicaid's 1992 reimbursement for the procedure codes most commonly used for each type of surgery. The amounts include reimbursement for physician services, facilities, and anesthesia.

### Estimating National Expenditures

To estimate national Medicaid per-capita expenditures for treatment of otitis media from Colorado figures, we needed to adjust for differences between Colorado and the United States as a whole in terms of price, number, and intensity of services. Based on 1991 figures of the Health Care Financing Administration regarding per-capita personal health care expenditures as a percentage of US average per-capita expenditures by type of service and state of residence,<sup>6</sup> we inflated Colorado expenditures by 15% for drugs, 13% for visits, and 2% for procedures. To estimate national per-capita expenditures by private insurers, we also ad-

**TABLE 1.** Colorado Medicaid's 1992 Reimbursement for Otitis Media Services

Visit Type	Reimbursement*
Primary care, brief	\$ 12.05
Primary care, limited	\$ 21.22
Primary care, intermediate	\$ 29.37
Primary care, extended	\$ 38.73
Primary care, comprehensive	\$ 47.60
ENT/specialist, brief	\$ 26.60
ENT/specialist, limited	\$ 43.38
ENT/specialist, intermediate	\$ 49.44
ENT/specialist, extended	\$ 62.03
ENT/specialist, comprehensive	\$ 62.03
Emergency department, brief	\$ 95.87
Emergency department, limited	\$ 104.74
Emergency department, intermediate	\$ 111.27
Emergency department, extended	\$ 117.52
Emergency department, comprehensive	\$ 123.68
Procedure	Reimbursement†
Tympanostomy with insertion of ventilating tubes (unilateral)	\$ 490.50
Tympanostomy with insertion of ventilating tubes (bilateral)	\$ 597.48
Mastoidectomy, simple	\$1160.91
Mastoidectomy, radical	\$1528.64
Tonsillectomy with adenoidectomy	\$ 530.46
Adenoidectomy without tonsillectomy	\$ 446.88
Adenoidectomy with tonsillectomy and bilateral ventilating tubes	\$ 778.16
Adenoidectomy with tonsillectomy and unilateral ventilating tubes	\$ 664.18

ENT indicates ear, nose, and throat.

\* Includes a \$85.51 facility fee for emergency department visits.

† Includes reimbursement for physician services, facility, and anesthesia.

justed for differences in reimbursement rates by service between Medicaid and private insurance. These numbers represent the ratio of private insurance reimbursement for visits and otitis media-related surgeries in Colorado in 1992 to Medicaid's 1992 reimbursement, based on a survey by the authors of private insurers. The ratio for visits was weighted to reflect the intensity of otitis media visits, and the ratio for surgeries was weighted to reflect the most common otitis surgeries. Private insurance reimbursement for visits was found to be 2.42 times that of Medicaid, whereas reimbursement for procedures was 3.22 times Medicaid's reimbursement. Drug costs were not adjusted because Medicaid's reimbursement approximated that of private insurers (A. Chapman, Colorado Medicaid Drug Utilization Review Director, personal communication, May 5, 1999). Expenditures for the uninsured were also estimated because, although the uncompensated cost of care for the uninsured is reflected to a great extent in private insurance rates, the uninsured also pay for a portion of the cost of their care. In addition to the above 2 adjustments, national per-capita expenditures for the uninsured were also adjusted for differences in utilization between Medicaid enrollees and the uninsured. Uninsured children were estimated to have only 45% as much utilization as children enrolled in Medicaid.<sup>7</sup> The result of these calculations was a set of per-capita reimbursement amounts by age, service, and insurer.

Age-specific reimbursement amounts were needed because the Medicaid population includes a greater proportion of younger children than does the privately insured population, owing to income eligibility levels that vary with age in most Medicaid programs. Because younger children also experience more episodes of otitis, applying average Medicaid expenditures per child to the privately insured population would overestimate expenditures.

Per-capita reimbursement amounts were applied to estimates of the US population in each category of age and source of health insurance. Population estimates by age for 1992 were obtained from the US Bureau of the Census. To apportion the total population for a given age category by type of insurance coverage, we applied age-specific percentages of the population who were un-

insured, covered by private insurance, or covered by Medicaid, as reported in the March 1993 Current Population Survey.<sup>8</sup>

People reporting multiple types of insurance in the March 1993 Current Population Survey were assumed to have been covered by both private insurance and Medicaid. We used 2 sets of assumptions to estimate expenditures for these people. Under the first assumption, people reporting multiple sources of insurance were assumed to have been covered by both insurers for the whole year. Under this assumption, expenditures were the same as they would have been for people with private insurance only, because for dually covered enrollees, Medicaid pays only premiums and copayments, which are unaffected by individual utilization. Under the second assumption, people reporting multiple insurance were assumed to have no overlap in insurance but to have been covered by each type of insurer for half of the year. In this case, the average of the per-capita reimbursement amount for private insurance and for Medicaid was calculated for each type of service, and these averages were used in the calculation of expenditures.

To provide a more current expression of medical expenditures for otitis media, we inflated the 1992 expenditure estimates to 1998 dollars using the Consumer Price Index published by the US Bureau of Labor Statistics. We used US city average inflation estimates for prescription drugs and medical supplies, hospital and related services, and professional services to inflate each component of expenditures we estimated.

## RESULTS

During 1992, 87 058 children 13 years of age and younger were continuously enrolled in the Colorado Medicaid Program. Of these, 24 677 experienced at least 1 episode of diagnosed otitis media. Table 2 shows the number and percentage of continuously enrolled Medicaid children with and without a diagnosis of otitis media according to age, gender, race, and urban versus rural residence. The proportion of children with a diagnosis of otitis media was highest

**TABLE 2.** Number and Percentage of Children Diagnosed With Otitis Media Among Children Continuously Enrolled in Colorado Medicaid During 1992, by Patient Characteristics

Characteristic	Children				
	With OM		Without OM		Total <i>n</i>
	<i>n</i>	%	<i>n</i>	%	
Age*					
0-6 mo	898	10.2	7901	89.8	8799
7-12 mo	3088	42.0	4263	58.0	7351
13-18 mo	3365	61.1	2146	38.9	5511
19-24 mo	2757	60.2	1819	39.8	4576
25-30 mo	2150	51.6	2017	48.4	4167
31-36 mo	1666	43.0	2211	57.0	3877
3-6 y	7362	27.9	18 979	72.1	26 341
7-9 y	2110	15.5	11 530	84.5	13 640
10-13 y	1280	10.0	11 513	90.0	12 793
Gender					
Male	12 949	29.2	31 456	70.8	44 405
Female	11 728	27.5	30 924	72.5	42 652
Race					
Native American	157	18.9	674	81.1	831
Hispanic	8154	25.3	20 040	74.7	32 194
White	13 797	34.5	26 183	65.5	39 980
Black	2 164	18.5	9528	81.5	11 692
Other	405	17.2	1955	82.8	2360
Residence†					
Urban	19 847	27.2	53 215	72.8	73 062
Rural	4830	34.5	9165	65.5	13 995
Total	24 677	28.3	62 380	71.7	87 057

\* Determined as of the end of the calendar year.

† Urban and rural designations are based on the Census Bureau's metropolitan statistical area methodology. A child's designation is defined by the county of residence for the first enrollment period of the calendar year.

(42%–60%) in the 7-month-old to 36-month-old age range. The proportion was also higher among white (34.5%) and Hispanic (25.3%) children than among black children (18.5%) as well as among rural (34.5%) compared with urban children (27.2%). The distributions in Table 2 were tested using the  $\chi^2$  test, and all were found to have probabilities  $<.001$ , owing to the large number of observations.

Average expenditures per continuously enrolled child with otitis media for drugs, visits, and procedures are shown in Table 3 according to age, gender, race, and urban versus rural residence. Children 19 to 24 months of age incurred the highest total annual expenditures per child with otitis media (\$239.68). All 3 components of expenditures (drugs, visits, and procedures) were highest for this group. The per-patient cost to Medicaid was greater for visits than for drugs or procedures across all age groups. Total per-patient expenditures were higher for males (\$174.67) than for females (\$154.47) and higher for white children (\$176.59) than for Hispanic (\$154.12) or black children (\$134.44). The differences among the ethnic groups can be attributed almost entirely to differences in expenditures for procedures and drugs.

The distributions of per-patient expenditures in all strata of the demographic characteristics and for all types of expenditures were highly skewed, with most patients having low expenditures and a few having much higher expenditures. Because the criteria for a normal distribution could not be met, the Kruskal-Wallis nonparametric test was used to compare the distributions of expenditures within each demographic variable. Owing to the large number of observations, significant differences were found for all of the variables. In particular, differences within

the age, gender, and race strata were found at the  $P < .01$  level. The distributions of expenditures for drugs and visits by urban versus rural residence were also different at the .01 level, but the distribution of expenditures for procedures did not vary with urban versus rural residence, and the distribution of total expenditures was significant only at the .05 level.

Despite these statistically significant findings regarding the means, when we used general linear model techniques to test the proportion of the variation in expenditures explained by these patient characteristics, we found it to be very small ( $R^2$  equal to .04 for total expenditures and expenditures for drugs, .09 for expenditures for visits, and .01 for surgical expenditures). To illustrate how a patient characteristic can be associated with a significant difference in mean expenditures while explaining only a small proportion of the variance in expenditures, one must consider the difference between the means in light of the range of expenditures. For example, the mean expenditure to treat otitis media in blacks was only 76% of that for whites, but the difference in the means (\$42.15) represents only 1.6% of the range of expenditures for blacks. Another indication that the differences between the distributions in Table 3 are not meaningful is that the differences between median expenditures were small. Indeed, in the example above, the median expenditure for blacks (\$103.44) was somewhat greater than that for whites (\$98.84).

Colorado's Medicaid expenditures for all continuously enrolled children (with and without otitis) are shown in Table 4. Again age-specific estimated expenditures per child peaked among children 1 (\$132.94) and 2 years of age (\$88.72). Children 3 to 6

**TABLE 3.** Per-Patient Expenditures for Treatment of Otitis Media Among Children Continuously Enrolled in Colorado Medicaid During 1992, by Patient Characteristics

Characteristic	n	Mean Expenditures				Range of Total Expenditures
		Drugs	Visits	Procedures	Total	
<b>Age*</b>						
0–6 mo	898	\$ 7.16	\$ 66.05	\$ 1.33	\$ 74.54	\$2.07–\$730.59
7–12 mo	3088	\$20.81	\$ 96.15	\$ 9.20	\$126.17	\$2.55–\$815.42
13–18 mo	3365	\$38.96	\$136.59	\$26.58	\$202.14	\$2.94–\$2486.61
19–24 mo	2757	\$46.76	\$137.99	\$54.93	\$239.68	\$2.94–\$2788.57
25–30 mo	2150	\$38.81	\$110.39	\$49.72	\$198.92	\$2.94–\$1964.71
31–36 mo	1666	\$31.21	\$ 93.35	\$47.12	\$171.68	\$2.94–\$4046.71
3–6 y	7362	\$37.35	\$ 74.14	\$41.19	\$152.68	\$2.25–\$3678.62
7–9 y	2110	\$36.75	\$ 57.59	\$44.36	\$138.71	\$2.23–\$3627.91
10–13 y	1280	\$32.47	\$ 50.66	\$30.24	\$113.38	\$1.35–\$4534.74
<b>Gender</b>						
Male	12 949	\$36.28	\$ 97.74	\$40.66	\$174.67	\$2.07–\$4534.74
Female	11 728	\$33.30	\$ 90.06	\$31.12	\$154.47	\$1.35–\$2534.59
<b>Race</b>						
Native American	157	\$25.40	\$ 84.71	\$22.83	\$132.94	\$2.55–\$1261.35
Hispanic	8154	\$32.36	\$ 91.16	\$30.60	\$154.12	\$2.07–\$2485.47
White	13 797	\$38.35	\$ 96.13	\$42.12	\$176.59	\$1.35–\$4534.74
Black	2164	\$23.46	\$ 93.05	\$17.93	\$134.44	\$2.55–\$2592.92
Other	405	\$31.05	\$ 92.50	\$45.65	\$169.20	\$2.94–\$4046.71
<b>Residence†</b>						
Urban	19 847	\$34.33	\$ 95.19	\$36.07	\$165.60	\$1.35–\$4534.74
Rural	4830	\$37.03	\$ 89.56	\$36.34	\$162.92	\$2.07–\$2486.61
Total	24 677	\$34.86	\$ 94.09	\$36.13	\$165.07	\$1.35–\$4534.74

\* Determined as of the end of the calendar year.

† Urban and rural designations are based on the Census Bureau's metropolitan statistical area methodology. A child's designation is defined by the county of residence for the first enrollment period of the calendar year.

**TABLE 4.** Per-Capita Expenditures for Treatment of Otitis Media Among Children Continuously Enrolled in Colorado Medicaid During 1992, by Age

Age* (in Years)	Per-Capita Expenditures				Colorado Medicaid	
	Drugs	Visits	Procedures	Total	Population	Expenditures
0	\$ 4.38	\$22.06	\$ 1.83	\$ 28.27	16 150	\$ 456 545
1	\$25.78	\$83.28	\$23.88	\$132.94	10 087	\$1 340 997
2	\$16.84	\$48.84	\$23.05	\$ 88.72	8044	\$ 713 687
3-6	\$10.44	\$20.72	\$11.51	\$ 42.67	26 341	\$1 124 015
7-9	\$ 5.69	\$ 8.91	\$ 6.86	\$ 21.46	13 640	\$ 292 676
10-13	\$ 3.25	\$ 5.07	\$ 3.03	\$ 11.34	12 793	\$ 145 123
Total	\$ 9.88	\$26.67	\$10.24	\$ 46.79	87 055	\$4 073 042

\* Determined as of the end of the calendar year.

years of age incurred expenditures only one third as great as those incurred by children 1 year of age.

Estimated national 1992 expenditures associated with the treatment of otitis media for all children 13 years of age and younger by age and service category are shown in Table 5. Total national expenditures are estimated to have been between \$4.09 and \$4.15 billion, depending on the assumption made regarding people with multiple sources of insurance. In 1998 dollars, these expenditures were estimated to be between \$5.24 and \$5.33 billion, again depending on the assumption made about people with multiple sources of insurance (Table 6). For all payers, expenditures were highest for visits.

#### DISCUSSION

Otitis media, a common childhood illness, is costly. A better understanding of the expenditures associated with managing otitis media is needed to determine the value of implementing new preventive and case management interventions. We estimated national 1992 medical expenditures for otitis media at approximately \$4.1 billion for children younger than 14 years of age. If nonmedical costs, such as parents' lost work time, were included, the estimate of the financial impact of otitis media would be much higher.

Nearly half of the expenditures associated with treatment of otitis media before 14 years of age are incurred before 3 years of age. The per-capita cost of treating otitis media in children between 1 and 3 years of age is estimated at \$453 in 1992 dollars. Vaccines designed to reduce the incidence of otitis media, therefore, are most likely to be cost-effective if they can be administered before the child's first birthday, when otitis media expenditures begin to grow.

Across all age groups, visits, rather than surgical procedures, accounted for the largest proportion of otitis-related expenditures. For example, children who were 19 to 24 months of age at the end of the study year experienced the highest per-patient expenditures for procedures, but these expenditures were still only 40% of the expenditures associated with visits. Even after adjustment for increased reimbursement from private insurers, expenditures for procedures were only 53% of expenditures for visits. This finding suggests that meaningful savings may be possible with even small reductions in the number of unnecessary visits. Insofar as there is considerable variation in practice patterns with regard to otitis media,<sup>3</sup> there may be room for improvement, and otitis media case management guidelines should emphasize reducing unnecessary visits by 2 strategies: 1) implementing better pneumatic otoscopy training for clinicians to reduce the overdiagnosis of acute otitis media and 2) scheduling follow-up visits for children who have become asymptomatic 3 to 4 weeks after diagnosis rather than after 10 to 14 days, allowing time for resolution of the middle ear effusion.

Although mean expenditures per patient varied substantially by some patient characteristics (eg, race), these differences should not be overemphasized. Even large percentage differences in the means of these characteristics accounted for only a small fraction of the enormous variation in costs per patient.

#### Limitations

This article estimates costs associated with the diagnosis of otitis media, as recorded in claims data. Our algorithm for identifying otitis media relied on recording of diagnoses at the 3-digit ICD-9 level in

**TABLE 5.** Estimated 1992 National Expenditures Associated With Otitis Media by Age and Type of Service

Age* (in Years)	US Population	Expenditures (in \$1000st)				Cumulative Percent
		Drugs	Visits	Procedures	Total	
0	3986	\$ 18 886	\$ 191 730	\$ 18 541	\$ 229 157	6%
1	3971	\$110 796	\$ 721 190	\$ 240 542	\$1 072 528	31%
2	3957	\$ 72 117	\$ 421 426	\$ 231 305	\$ 724 847	49%
3-6	14 980	\$168 884	\$ 685 005	\$ 443 923	\$1 297 812	80%
7-9	10 882	\$ 66 411	\$ 221 513	\$ 200 718	\$ 488 641	92%
10-13	14 621	\$ 50 532	\$ 169 616	\$ 119 364	\$ 339 512	100%
Total	52 397	\$487 626	\$2 410 479	\$1 254 392	\$4 152 497	

\* Determined as of the end of the calendar year.

† Expenditures were calculated assuming that people reporting multiple sources of insurance were covered by both insurers simultaneously.

**TABLE 6.** Estimated 1998 National Expenditures for Treatment of Otitis Media, by Service and Source of Insurance

Insurance	Expenditures (in 1000s)			
	Drugs	Visits	Procedures	Total
Private	\$395 672	\$2 323 707	\$1 358 613	\$4 077 992
Medicaid	\$185 275	\$ 355 716	\$ 147 955	\$ 688 946
None	\$ 31 509	\$ 184 361	\$ 108 010	\$ 323 880
Multiple, assuming overlap*	\$ 28 567	\$ 179 263	\$ 98 046	\$ 305 876
Total, assuming overlap	\$641 023	\$3 043 047	\$1 712 624	\$5 396 694
Multiple, assuming no overlap†	\$ 28 567	\$ 126 669	\$ 64 245	\$ 219 481
Total, assuming no overlap	\$641 023	\$2 990 453	\$1 678 823	\$5 310 299

\* People reporting multiple sources of insurance are assumed to have been covered by private insurance and Medicaid simultaneously for the full year.

† People reporting multiple sources of insurance are assumed to have been covered by private insurance and Medicaid, each for half of the year.

combination with the presence of an antibiotic fill, a technique that has been shown to have 96% agreement with the medical chart.<sup>4</sup> Although the estimate so obtained may underestimate the actual incidence of otitis media, for the purposes of estimating costs, it is appropriate because episodes of otitis media that do not result in visits to a health care provider have no impact on cost. Moreover, our estimate of cumulative otitis media among children 7 to 12 months of age (42%) is similar to the estimate by Duncan et al<sup>9</sup> of otitis media among children 1 year of age (47%).

This study assesses expenditures from the point of view of the health care system; that is, no social costs, such as lost work time, or expenditures not normally covered by insurance, such as those for transportation, are included. The study captures expenditures to treat otitis media during a calendar year and should not be interpreted as the cost to treat episodes of otitis media. Our reported expenditures may have captured only part of an episode straddling 2 calendar years, or, alternatively, they may cover several episodes. Our findings underestimate annual expenditures for children younger than 1 year of age because these children were followed for only a fraction of a year. The estimates of Colorado Medicaid's expenditures for drugs may be high because they are based on the dose that would be given to a child at the 95th percentile of weight for his age. Counteracting this effect is the fact that we imputed costs based on the lowest-cost form (ie, tablet vs liquid) of a drug when more than 1 form was appropriate for a given age. Our extrapolations to national expenditures are, of course, subject to the accuracy of our assumptions. If the ratio of Medicaid reimbursement to private insurance reimbursement is different in Colorado than in the rest of the country, our estimates of national private insurance payments will be affected. The adjustment we made for lower utilization among the uninsured is based on studies of physician visits; the ratio of utilization by the uninsured to utilization by the insured may be different for drugs and procedures, but no such data were available. Our estimates of population covered by each type of insurance are based on the Current Population Survey of the US Census Bureau. The wording of this survey makes it impossible to know whether people reporting multiple sources of insurance were covered by

these sources simultaneously, at different times, or some of each. These scenarios have different implications for expenditures, so we developed estimates under 2 different and extreme sets of assumptions.

The figures reporting 1992 expenditures expressed in 1998 dollars should not be taken as an estimate of 1998 expenditures to treat otitis media. The approach used to adjust the expenditures did not take into account changes in the medical practice environment, such as would occur with a movement of the population from predominantly fee-for-service practice to managed care or the introduction of new treatment practices. It also did not account for changes in insurance status, eg, an increase in the proportion of uninsured children, or for population increases.

Most importantly, our estimates of expenditures are based on treatment of otitis media as it was practiced in 1992, before the current practice guidelines<sup>10</sup> were promulgated. The effect of the guidelines on physician practice in 1992 may, however, not have been substantial; Christakis and Rivara<sup>11</sup> found that only 50% of pediatricians were aware of the otitis media guidelines and of these only 28% believed that they had changed their practice as a result of the guidelines. It is important to remember that our estimates are based on 1992 Medicaid utilization. Given Medicaid's low reimbursement to primary care physicians at that time, doctors would have had little financial incentive to see patients more often than necessary. Thus, insofar as practice guidelines encouraged fewer visits, Medicaid utilization may already reflect close adherence to the practice guidelines.

## CONCLUSION

As new vaccines are introduced, the data presented in this article will provide a baseline with which to monitor reductions in the frequency and expenditures for treatment of otitis media in childhood.

National otitis media-related Medicaid expenditures during 1992 for 12.5 million Medicaid children younger than 14 years of age were at least \$555.3 million. National otitis media-related health care expenditures for all 52.4 million children younger than 13 years of age were estimated to be approximately \$4.1 billion.

Visits, rather than surgical procedures, accounted for the largest proportion of total otitis-related expenditures across all age groups and payers. Based on these findings, it may be appropriate for otitis media case management guidelines to emphasize reducing unnecessary visits, for instance, by improving physician training in pneumatic otoscopy, which has been shown to be critical to an accurate diagnosis of otitis media,<sup>12</sup> and by lengthening the interval between diagnosis and routine follow-up visits.

Over 40% of all expenditures to treat otitis media in children younger than 14 years of age are incurred for children between 1 and 3 years of age. Including children with and without otitis media, the per-capita expenditure for children in this age group is \$453 over these 2 years of life and \$1027 for all years of age from 2 to 13. This finding suggests the magnitude of the potential savings from vaccines and other preventive measures that markedly reduce the incidence of otitis media, especially if they can be administered before the child's first birthday.

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#### REFERENCES

1. Wade TD, Byrns PJ, Steiner JF, Bondy J. Finding temporal patterns—a set-based approach. *Artif Intell Med*. 1994;6:263–271
2. Byrns PJ, Bondy J, Glazner JE, Berman S. Utilization of services for otitis media by children enrolled in Medicaid. *Arch Pediatr Adolesc Med*. 1997;151:407–413
3. Roark R, Petrofski J, Berson E, Berman S. Practice variations among pediatricians and family practice physicians in the management of otitis media. *Arch Pediatr Adolesc Med*. 1995;149:839–844
4. Quam L, Ellis LB, Venus P, et al. Using claims data for epidemiologic research: the concordance of claims-based criteria with the medical record and patient survey for identifying a hypertensive population. *Med Care*. 1993;31:498–507
5. Berman S, Byrns PJ, Bondy J, Smith PJ, Lezotte D. Otitis media-related antibiotic prescribing patterns, outcomes, and expenditures in a pediatric Medicaid population. *Pediatrics*. 1997;100:585–592
6. Basu J. Border-crossing adjustment and personal health care spending by state. *Health Care Finance Rev*. 1996;18:215–236
7. Newacheck PW, Pearl M, Hughes DC, Halfon N. The role of Medicaid in ensuring children's access to care. *JAMA*. 1998;280:1789–1793
8. Newacheck PW, Hughes DC, Cisternas M. Children and health insurance: an overview of recent trends. *Health Aff (Millwood)*. 1995;14:244–254
9. Duncan B, Ey J, Holberg C, et al. Exclusive breast feeding for at least 4 months protects against otitis media. *Pediatrics*. 1993;91:867–872
10. Agency for Health Care Policy and Research. *Managing Otitis Media With Effusion in Young Children*. Rockville, MD: Public Health Service, US Department of Health and Human Services; 1994. Agency for Health Care Policy and Research Publication 94-0623
11. Christakis DA, Rivara FP. Pediatricians' awareness of and attitudes about four clinical practice guidelines. *Pediatrics*. 1998;101:825–830
12. Berman S. Otitis media in children. *N Engl J Med*. 1995;332:1560–1565

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