Impact of a Medicaid Primary Care Provider and Preventive Care on Pediatric Hospitalization

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ABSTRACT. ***Objective.*** **This study evaluates the impact that a Medicaid managed care program had on avoidable hospitalization, a form of health care misuse that we hypothesize can be reduced by improved access to and quality of primary care in the context of a managed care program. Ambulatory care sensitive (ACS) hospitalizations, a previously defined categorization of hospitalization, as well as all pediatric hospitalizations were also studied.**

Intervention. **The Maryland Access to Care (MAC) was a fee-for-service, gatekeeper, Medicaid managed care program with assigned primary medical providers and required Early Periodic Screening, Diagnosis, and Treatment (EPSDT) examinations. Medicaid managed care elements include: 1) assignment to primary medical provider (PMP) either by voluntary choice or mandatory enrollment of eligible Aid to Families With Dependent Children (AFDC), Medical Assistance (medical needy), and Supplemental Security Income; 2) a medical home accessible 24 hours a day, 7 days a week; 2) PMP must authorize emergency department (ED), inpatient, and specialty care but there were no disincentives to PMP for referral; 3) fee-for-services reimbursement (with a physician rate increase) for primary care, authorized specialist care, and hospitalization; and 4) an on-line eligibility verification system was available to all medical providers. Pre-enrollment as well as publicity allowed MAC to be phased in rapidly, resulting in 70% to 80% enrollment by the end of the first program year.**

Design. **The design of this study is that of a pre- and postevaluation of the MAC program using Medicaid claims analysis of data 3 years pre-MAC and 2 years post-MAC. In multivariate analyses, this study also compares MAC-enrolled children to non–MAC-enrolled children (before and after MAC began) to estimate the impact of MAC enrollment while controlling for potential confounders.**

Setting. **State of Maryland from 1989 to 1993.**

Patients. **MAC-eligible children ≤18 years of age.**

Outcome Measures. **Claims data were used to define avoidable hospitalization (based on ambulatory care received before hospitalization), to define ACS hospitalizations (based on the *International Classification of Diseases–Clinical Modification, Ninth Revision* [ICD-9-CM] codes), and to summarize use of ambulatory and inpatient care.**

Avoidable hospitalizations include those conditions for which evidence exists that specific ambulatory care modalities reduce hospitalization rates. These hospitalizations were defined by combining the first ICD-9-CM on an inpatient claim with ambulatory and/or pharmacy claims for services before that hospitalization. The criterion of preceding ambulatory care was applied by linking dates of admission to hospital with ambulatory service dates. An example of an avoidable hospitalization is a hospitalization for asthma (ICD-9-CM = 493) that has no antecedent pharmacy claim for steroids.

ACS hospitalizations have been defined as those conditions for which timely and effective primary care can help to reduce the risk of hospitalizations. These are based solely on ICD-9-CM discharge codes that were studied by Billings and Teicholz[11] in 1990 and used by an Institute of Medicine report[12] in 1993. Examples include hospital discharge diagnoses of asthma (ICD-9-CM = 493), gastroenteritis (ICD-9-CM = 558.9), and dehydration (ICD-9-CM = 276.5).

Usage measures, such as preventive care visits or ED visits, were created using Maryland Medicaid codes, Current Procedural Terminology codes, and ICD-9-CM codes. Linear regression was used to model trend.

Logistic regression was used to model the probability of ambulatory and inpatient care given MAC enrollment and other covariates. First, logistic regression was used to predict the probability of any ambulatory care use among all MAC-eligible children during a quarter to model changes in access that may have occurred during MAC. Then, among users of ambulatory care or inpatient care, logistic regression was used to predict the probability of hospitalization.

Results. **Most of the children studied were in the AFDC program, about half were African-American, one third resided in Baltimore City, and 9% of children had ICD-9-CMs reflecting chronic disease. The mean percentage of time children were MAC-eligible per quarter was 91%. Only 5% of children were continuously enrolled for all 20 quarters included in this study.**

Per-capita ambulatory care visits, especially per-capita preventive care visits, increased significantly during the study period (b = 0.003) whereas per-capita ED visits did not change. The mean number of preventive visits was 0.2 visits/quarter for MAC-enrolled children compared with 0.1 visits/quarter for nonenrolled children. Although the mean number of ED visits was the same (0.06 visits/quarter) during the pre- and post-MAC periods, the mean number of ED visits for MAC-enrolled children was slightly higher than nonenrolled children (0.065 versus 0.057 visits per quarter).

Because multiple factors affect use, multivariate analysis was used to adjust for potential confounders. With all 3.2 million child-quarter observations included in the regression, MAC enrollment (odds ratio [OR] = 2.2, 95% confidence interval [CI] = 2.17–2.22) was strongly asso-

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ciated with the probability of any preventive care visits (1 or more). MAC enrollment was also associated with an increased probability of any ED use (OR = 1.4, 95% CI = 1.42–1.46) or any ambulatory care visit (OR = 2.58, 95% CI = 0.57–2.60).

Among those children who used ambulatory care (1.2 million child-quarters), MAC enrollment was associated with a lower probability of avoidable (OR = 0.89, 95% CI = 0.83–0.97) and any hospitalization (OR = 0.81, 95% CI = 0.79–0.84), but no change in ACS hospitalization (OR = 0.96, 95% CI = 0.92–1.01). With multiple hospitalizations per quarter excluded, MAC enrollment was associated with a reduced probability of avoidable (OR = 0.86, 95% CI = 0.80–0.93), ACS (OR = 0.93, 95% CI = 0.88–0.98), and any pediatric hospitalization (OR = 0.79, 95% CI = 0.76–0.81). The probability of an avoidable hospitalization was inversely related to the number of preventive care visits (OR = 0.70, 95% CI = 0.67–0.74) and directly related to ED visits (OR = 2.11, 95% CI = 2.06–2.16).

Conclusions. **Enrollment in the MAC program and preventive care were associated with a reduced probability of avoidable as well as any pediatric hospitalization. Given the strong association between preventive care and reduced probability of hospitalization, it is likely that MAC exerts a positive effect on hospitalization through augmented preventive care, ie, numbers of preventive care visits, required EPSDT, increased access, and provider continuity. Further research is needed to document the clinical effectiveness of preventive care for children.** ***Pediatrics*** **1998;101(3). URL: http://www.pediatrics.org/cgi/content/full/101/3/e1;** ***Medicaid, avoidable hospitalization, preventive care, pediatric hospitalization.***

ABBREVIATIONS. MAC, Maryland Access to Care (program); ED, emergency department; EPSDT, Early Periodic Screening, Diagnosis, and Treatment; ACS, ambulatory care sensitive (hospitalizations); MA, Medical Assistance; ICD-9-CM, *International Classification of Diseases–Clinical Modification, Ninth Revision*; AFDC, Aid to Families With Dependent Children; SSI, Supplemental Security Income; HMO, health maintenance organization; PMP, primary medical provider; FY, fiscal year; NS, not significant; OR, odds ratio; 95% CI, 95% confidence interval.

Historically, key health care problems plaguing Medicaid programs have been high enrollee turnover, episodic and fragmented care, duplicated testing, doctor shopping, preventable hospitalization, and multiple prescriptions.[1] Nevertheless, Medicaid has been shown to increase access to preventive and curative services.[2–4] Currently, Medicaid managed care programs face the dual and seemingly conflicting necessities for reducing costs while increasing access. Evaluations of Medicaid managed care programs have produced inconclusive results to date regarding their success in achieving these goals.[5–7]

In December 1991, the state of Maryland instituted a Medicaid managed care program called Maryland Access to Care (MAC), which was designed to maintain access, strengthen primary care ties, increase preventive services, and decrease emergency department (ED) visits. MAC was a fee-for-service primary care case management program with mandatory enrollment and an assigned primary care provider who was required to provide gatekeeping and Early Periodic Screening, Diagnosis, and Treatment (EPSDT) services. Higher reimbursement for physicians was an added feature that encouraged provider participation. Thus, MAC addressed key problems that Medicaid programs have had, ie, lack of preventive and primary care, lack of physician participation, and fragmented care.[8]

This study evaluates the impact that MAC had on avoidable hospitalization, a form of health care misuse that we hypothesize can be reduced by improved access to and quality of primary care in the context of a managed care program. Ambulatory care sensitive (ACS) hospitalizations, a previously defined categorization of hospitalization, were also studied to compare ACS results to those derived using avoidable hospitalization. Because hospital care accounted for 40% of 1990 Medicaid expenditures,[9] the impact of MAC on all pediatric hospitalizations was also examined.

METHODS

The design of this study is that of a pre- and postevaluation of the MAC program using Medicaid claims data analysis of data 3 years pre-MAC and 2 years post-MAC. In multivariate analyses, this study also compares MAC-enrolled children to non–MAC-enrolled children (before and after MAC began) to estimate the impact of MAC enrollment while controlling for potential confounders. The primary data source for this study was the Medicaid health service claims from 1989 through 1993 from the Maryland Medical Assistance (MA) Program as supplied by Project HOPE Center for Health Affairs. Project HOPE compiled data files for claims analysis as part of the Health Care Financing Administration funded overall evaluation of MAC, which included the 3-year baseline period for this analysis beginning December 1, 1988, and ending November 30, 1991, and 2 MAC years from December 1, 1991, to November 30, 1993. These Medicaid data included demographic data, health services use, two *International Classification of Diseases–Clinical Modification, Ninth Revision* (ICD-9-CM) diagnosis codes per claim, MAC enrollee status, and recipient aid category. MAC eligibility criteria were applied to all Medicaid recipients <19 years of age represented in the eligibility file to select the appropriate pool of baseline recipients and claims for comparison to the post-MAC period. Inpatient, physician, outpatient, and pharmacy claims were used to create the outcome measures.

Hospital medical records at the University of Maryland Hospital in Baltimore, Maryland, which were reviewed by the Quality Management Department were another source of data. ICD-9-CM discharge codes for avoidable hospitalization were compared with what was documented in the medical record.

The Maryland State hospital discharge database from the Health Services Cost Review Commission was used to verify the number of pediatric hospitalizations paid for by Medicaid during corresponding calendar years.

Study Population

MAC included children eligible for Aid to Families With Dependent Children (AFDC), Supplemental Security Income (SSI) and MA (AFDC-related assistance to disabled, medically needy children and eligible relatives). MAC excluded children in foster care or nursing homes, refugees, health maintenance organization (HMO) enrollees and those dually eligible for Medicare and Medicaid. Medicaid eligibility in Maryland included pregnant women and infants in families with incomes up to 185% of the federal poverty level and children in families with incomes <100% of the poverty level. Medicaid program expansions in 1989 and 1990 preceded and coincided with the initiation of MAC, resulting in a 77% increase in Medicaid payments from 1987 to 1991.[10] The unemployment rate in Maryland peaked at 6.6 in 1992, which coincides with the first year of MAC. These changes as well as a

January 1993 State of Maryland requirement that immunization status and well-child visits be up to date for AFDC benefits to be received, brought many new children into the well-child screening process, including EPSDT. During 1991, Medicaid HMOs grew, particularly in Baltimore, but these HMOs did not supply encounter data, and thus cannot be compared with MAC. Of the 26 000 enrolled in Medicaid HMOs, 91% were in AFDC, 8% in MA, and 61% resided in Baltimore.

Medicaid Managed Care Typology

Medicaid managed care elements include: 1) assignment to primary medical provider (PMP) either by voluntary choice or mandatory enrollment of eligible AFDC, MA, and SSI; 2) a medical home accessible 24 hours/day, 7 days a week; 2) PMP must authorize ED, inpatient, specialty care but there were no disincentives to PMP for referral; 3) PMP was required to do EPSDT screens; 4) fee-for-services reimbursement (with rate increase) for primary care, authorized specialist care, hospitalization, and long-term care; and 5) an on-line eligibility verification system was available to all medical providers. Pre-enrollment as well as publicity allowed MAC to be phased in rapidly, resulting in 70% to 80% enrollment by the end of the first program year.

Outcome Definitions

Avoidable hospitalizations include those conditions for which evidence exists that specific ambulatory care modalities reduce hospitalization rates. These hospitalizations were defined by combining the first ICD-9-CM on an inpatient claim with ambulatory and/or pharmacy claims for services before that hospitalization. An example of an avoidable hospitalization is a hospitalization for asthma (ICD-9-CM = 493) that has no antecedent pharmacy claim for steroids. (See Appendix A for complete list.)

ACS hospitalizations have been defined as those conditions for which timely and effective primary care can help to reduce the risk of hospitalizations. These are based solely on ICD-9-CM discharge codes that were studied by Billings and Teicholz in 1990[11] and used by an Institute of Medicine report in 1993.[12] Examples include hospital discharge diagnoses of asthma (ICD-9-CM = 493), gastroenteritis (ICD-9-CM = 558.9), and dehydration (ICD-9-CM = 276.5). Adult conditions (angina, congestive heart failure, hypertension, chronic obstructive pulmonary disease) and dental conditions were excluded, and the pediatric version of ACS was used (Office of Research and Statistics, South Carolina State Budget and Control Board. *Pediatric Ambulatory Care Sensitive Conditions in South Carolina.* Unpublished report, July 19, 1995; see Appendix B for list.)

Any hospitalization includes all hospitalizations for which an inpatient claim was submitted, excluding psychiatric (Diagnosis-Related Group [DRG] 425–437), newborn (DRG 385–391) and long-term hospitalizations (as indicated by Maryland Medicaid Code nature = 5). These exclusions were necessary because either these conditions were not the focus of the MAC program, or affected children are typically not eligible for avoidable or ACS hospitalization as defined by this study.

Validation of ICD-9-CM Codes Used to Define Avoidable Hospitalizations

A panel of 8 board-certified pediatricians reviewed the discharge diagnoses that were classified as avoidable hospitalizations based on a literature review. The avoidable discharge diagnoses were reviewed for medical plausibility, need for qualification, and the certainty with which they could or could not be linked with the adequacy of primary care as it existed from 1988 to 1993. Methods for achieving consensus were used that are similar to those used in previous studies to rate the appropriateness of procedure indications.[13] As a result of this process, the number of avoidable conditions was reduced and clinical qualifiers were added that would classify some avoidable conditions as unavoidable. Appendix A lists the final clinical specifications.

A random sample of 337 hospital records containing the ICD-9-CM codes reflecting the avoidable conditions was drawn at the University of Maryland Hospital in Baltimore. Single admissions of children hospitalized from 1990 to 1993 were reviewed by trained utilization review nurses. Review of the first ICD-9-CM code compared with the first written discharge diagnosis revealed a 97% concordance. Among the nine mismatches of the first ICD-9-CM and the written discharge diagnosis, the index ICD-9-CM was listed among the other discharge diagnoses as well as the admitting diagnosis.

Construction of the Analysis File

Because our logistic regression equations were to be estimated for time-series data, we used the various Medicaid claims and eligibility databases described above to construct a Child-Quarter Analysis File. This file consisted of child-level data for the 20 analysis quarters defined around the December 1991 MAC implementation date, resulting in 12 pre-MAC and 8 post-MAC quarters. The date of service for each service type for each fiscal year (FY) [FY 89 to FY 95] was used to subdivide the analysis variables in question into 20 quarters. These child-quarter observations were then merged with the child-quarter records containing demographic and eligibility data. Thus, construction of the final analysis file involved the following steps. First, Medicaid recipients who met MAC eligibility criteria were identified. Then all claims that occurred during eligibility periods were retrieved. Duplicate claims were then removed. Usage measures were then created using Maryland Medicaid codes, Current Procedural Terminology codes and ICD-9-CM codes. Child-quarters were created using eligibility dates that correspond to 20 analysis quarters. If a recipient was eligible for MAC at any time during one of these analysis quarters, then (s)he had an observation for that quarter in the file. If a child had been eligible for MAC during a given quarter, yet had no use of a particular type of service during that quarter, then the child was assigned a zero for that service in that quarter.

In all, seven variables were created for each child-quarter to summarize the child's use of ambulatory and inpatient care for that quarter for regression analyses. The specific use variables created were the number of avoidable hospitalizations, ACS hospitalizations, total hospitalizations, primary care visits, specialty care visits, emergency room visits, EPSDT or preventive care visits. Using the clinical specifications summarized in Appendix A, claims for specific types of ambulatory care (visits or prescriptions) preceding an inpatient claim for an avoidable condition were used to classify avoidable hospitalizations. The criterion of preceding ambulatory care was applied by linking dates of admission to hospital with ambulatory service dates, irrespective of quarter. Inpatient claims for avoidable ICD-9-CM discharge diagnoses where outpatient, physician, or pharmacy claims existed to document that the ambulatory care modality had been received were reclassified as unavoidable and included with all other hospitalizations in the analysis. ACS hospitalizations were defined using inpatient claim ICD-9-CM codes with some qualifiers as presented in Appendix B, which allows hospitalizations to be classified as either ACS or not.

Analysis

Pre-MAC Versus Post-MAC Quarter Comparisons

Per-capita use rates were calculated for each quarter for each of the created variables. Linear regression was then used to model the trend in these rates controlling for seasonal variables (winter, spring, summer) and trend (quarter–1). Linear regression compared later quarters with earlier quarters and pre-MAC to post-MAC quarters to establish whether use changed significantly.

MAC-Enrolled Children Versus Non–MAC-Enrolled Children Analyses

To determine whether MAC enrollment independently affects hospitalization, a multi-equation approach to modeling use was adapted from methods used by Leibowitz 1992.[14] First, logistic regression was used to predict the probability of any ambulatory care use among all MAC-eligible children during a quarter to model changes in access that may have occurred during MAC. Then, among users of ambulatory care or inpatient care, logistic regression was used to predict the probability of hospitalization.

A series of multivariate analyses were performed for each type of hospitalization using avoidable, ACS, and all hospitalizations as the dependent variable. The child-quarter was the unit of analysis.

Independent variables from the Medicaid eligibility file were included to adjust for known correlates of hospitalization,[15,16] ie, Medicaid recipient's age, gender, race, county of residence (ordered by population size) and eligibility group. Eligibility was included to account for the chronic illness present in the SSI group. Referent groups for gender, race and eligibility were female, races other than white or African-American, and MA, respectively. To determine which ambulatory care visits independently affect hospitalization, the number of ambulatory care visits and the type were entered as independent variables in this model for each type of hospitalization. To address whether multiple hospitalizations of the same child violate independence assumptions for logistic regression modeling, the logistic regression model was also performed with only the first hospitalization per quarter included. All analyses were performed using the Statistical Analysis System (SAS) (Cary, NC) version 6.12.

RESULTS

The demographics of the population studied are presented in Table 1, as both child-quarters and actual numbers of children included in the analysis. Most of the children were in the AFDC program, about half were African-American and one third resided in Baltimore City. Although only 9% of children had ICD-9-CMs reflecting chronic disease, they account for 26% of child-quarter observations, as expected. The mean percentage of time children were MAC-eligible per quarters was 91%. Only 5% of children were continuously enrolled for all 20 quarters included in this study.

Pre-MAC Versus Post-MAC Quarter Comparisons: Ambulatory Care Trends

Figure 1 shows trends in ambulatory, specialty, preventive, and primary care visits for 20 quarters. Per capita preventive care visits increased significantly during the study period ($b = 0.003$, $P = .001$) and during the MAC quarters ($b = 0.03$, $P = .0001$). Specialty care visits also increased during the study period ($b = 0.006$, $P = .002$), but not significantly during the MAC period ($b = 0.03$, not significant [NS]). Per-capita ED visits did not change during the study period ($b = 0.0004$, NS) or MAC period ($b = -0.005$, NS).

Figure 2 shows trends in preventive care for 20 quarters stratified by eligibility group. The AFDC group shows a significant increase in per capita preventive care during the study period ($b = 0.0015$, $P = .004$) and during the MAC quarters ($b = 0.029$, $P = .0001$). During the study period, the largest increase in per capita preventive care occurred among the MA group ($b = 0.009$, $P = .0002$); however, this increase precedes the MAC program and appears to level off during the MAC period ($b = .01$, NS). The SSI group has a steady rate of preventive care that increases slightly during MAC quarters ($b = 0.013$, $P = .04$). The levels of preventive care use differ by eligibility group due, in part, to age differences among the eligibility groups. Age was negatively correlated with the number of preventive care visits (Pearson correlation coefficient = −0.23, $P = .0001$) and the mean age of the three eligibility groups was significantly different (F value = 75368, $P = .0001$), as would be expected.

TABLE 1. Population Studied: MAC-Eligible Children Who Used Ambulatory Care

	Child-Quarters (n = 1.2 million)	Children (n = 158 025)
Mean age (y)	4.8	3.3
AFDC	77%	68%
SSI	4%	2%
MA	19%	30%
Female	50%	51%
Black	56%	53%
White	40%	43%
Baltimore City	36%	34%
Chronic disease	26%	9%

Chronic disease is defined as having a first or second ICD-9-CM listed on a claim in one of the following categories: 042-4 (HIV infection), 277 (other immune deficiencies), 250 (diabetes), 282.6 (sickle cell anemia), 745-747.6 (cardiac anomalies), 140-208 (malignancies), 210-229 (benign neoplasms, hemangiomas), 230-234 (carcinoma in situ), 235-239 (other neoplasms), 493 (asthma), 585-6 (renal disease), 758 (chromosomal anomalies), 759 (congenital anomalies), 318 (mental retardation), 343 (cerebral palsy), and 277 (metabolic disorders, cystic fibrosis).

Pre-MAC Versus Post-MAC Quarter Comparisons: Hospitalization Trends

The crude 5-year hospitalization rate of MAC-eligible children, 48,023/464/313 or 103/1000, is high reflecting the characteristics of this population (young, predominantly non-white, Medicaid population in Maryland) that place it at a higher risk of hospitalization.[15,17,18] During the study period, there was a significant downward trend ($b = -0.004$, $P = .0001$) in overall per capita hospitalization rates for MAC-eligible children (not shown), consistent with the nationwide trend for declining hospitalization rates for children.[19] However, the MAC quarters ($b = 0.004$, $P = .0001$) as well as winter quarters ($b = 0.0025$, $b = 0.003$) were associated with relative increases in hospitalization. There were significant downward trends for all three eligibility groups during the study period (AFDC $b = -0.0003$, $P = .0001$; MA $b = -0.002$, $P = .0001$; SSI b = −0.0009, $P = .02$). There were no clear trends in avoidable hospitalization, except for the expected seasonal variation, with a winter average peak of 0.0022 hospitalizations per quarter and summer average nadir of 0.0011 hospitalization per quarter.

Of the 7702 avoidable hospitalizations, 92% could also be classified as ACS. Of the 18 902 ACS hospitalizations, 38% were avoidable, 12% were unavoidable, and 50% could not be classified using avoidable criteria because these criteria did not address certain ACS conditions (eg convulsions, nutritional, surgical, tuberculosis, etc). Thus, avoidable hospitalizations represent a subset of ACS hospitalizations, that have been verified as not having received the preventive ambulatory care modality. ACS classification, on the other hand, appears to misclassify at least 12% of hospitalizations as avoidable, when in fact the children admitted received preventive prehospitalization ambulatory care.

MAC-Enrolled Children Versus Non–MAC-Enrolled Children Analyses

The mean number of preventive visits was 0.2 visits/quarter for MAC-enrolled children compared with 0.1 visits/quarter for nonenrolled chil-

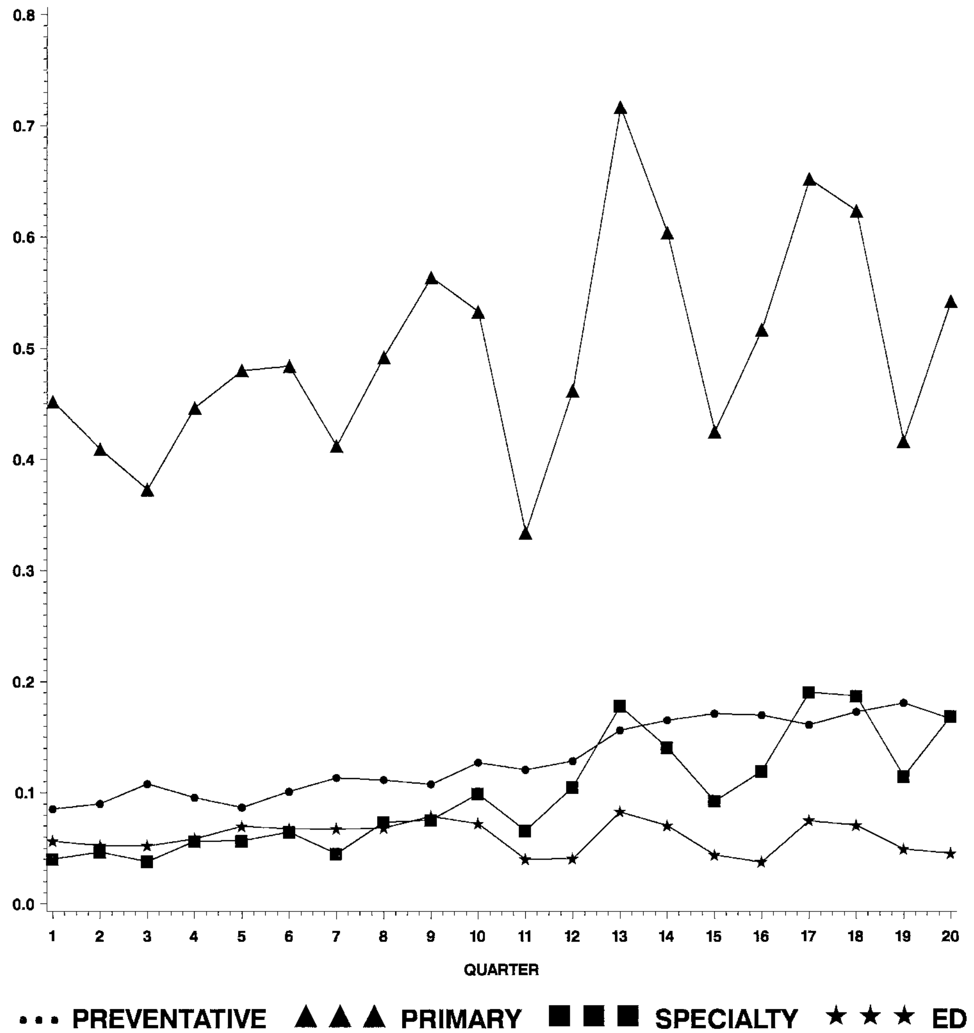

Fig 1. Per-capita ambulatory care visits made by MAC-eligible children during the 5-year study period, 1989 to 1993. The MAC program began at quarter 13. ED, emergency department.

dren (P = .001). Although the mean number of ED visits was the same (0.06 visits/quarter) during the pre- and post-MAC periods, the mean number of ED visits for MAC-enrolled children was slightly higher than nonenrolled children (0.065 vs 0.057 visits per quarter, P = .001). Because multiple factors affect use, multivariate analysis was used to adjust for potential confounders for both ambulatory care use and hospitalization for each child. With all child-quarter observations included in the regression, MAC enrollment (odds ratio [OR] = 2.2, 95% confidence interval [CI] 2.17–2.22) was strongly associated with the probability of any preventive care visits (1 or more) as shown in Table 2. Each OR reflects adjustment for the other independent variables included in the equation. MAC enrollment was also associated with an increased probability of any ED use (OR = 1.4, 95% CI 1.42–1.46) or any ambulatory care visit (OR = 2.58, 95% CI 0.57–2.60). SSI eligibility, younger age groups, urban residence, and white race were also associated with a greater probability of any ambulatory care use, whereas black race and AFDC eligibility were associated with a decreased probability.

The impact of the MAC program on hospitalization is shown in Table 3. This model includes children only if they used ambulatory care because MAC enrollment without ambulatory care use would not be expected to affect hospitalization. In this model, MAC enrollment was associated with a lower probability of avoidable hospitalization (OR = 0.89, 95% CI 0.83–0.97) and any hospitalization (OR = 0.81, 95% CI 0.79–0.84) but no change in ACS hospitalization (OR = 0.96, 95% CI 0.92–1.01). Younger age groups, female gender, urban residence, and SSI recipients were variables associated with a greater probability of avoidable and ACS hospitalization. AFDC ORs are low because they reflect disease severity relative to SSI and MA (the referent group was MA). Thus, program eligibility classifications operate as rough proxies of disease severity as described in other Medicaid studies.[20]

Table 4 shows the results of logistic regression with the number and types of ambulatory visits added to the model. In this model, the probability of an avoidable hospitalization was inversely related to preventive care visits (OR = 0.70, 95% CI 0.67–0.74) and directly related to ED visits (OR = 2.11, 95% CI 2.06–2.16). Preventive visits were also associated with lower ORs for ACS (OR = 0.83, 95% CI 0.80–0.85) and any hospitalization (OR = 0.91, 95% CI 0.89–0.93). Specialty care visits were also inversely

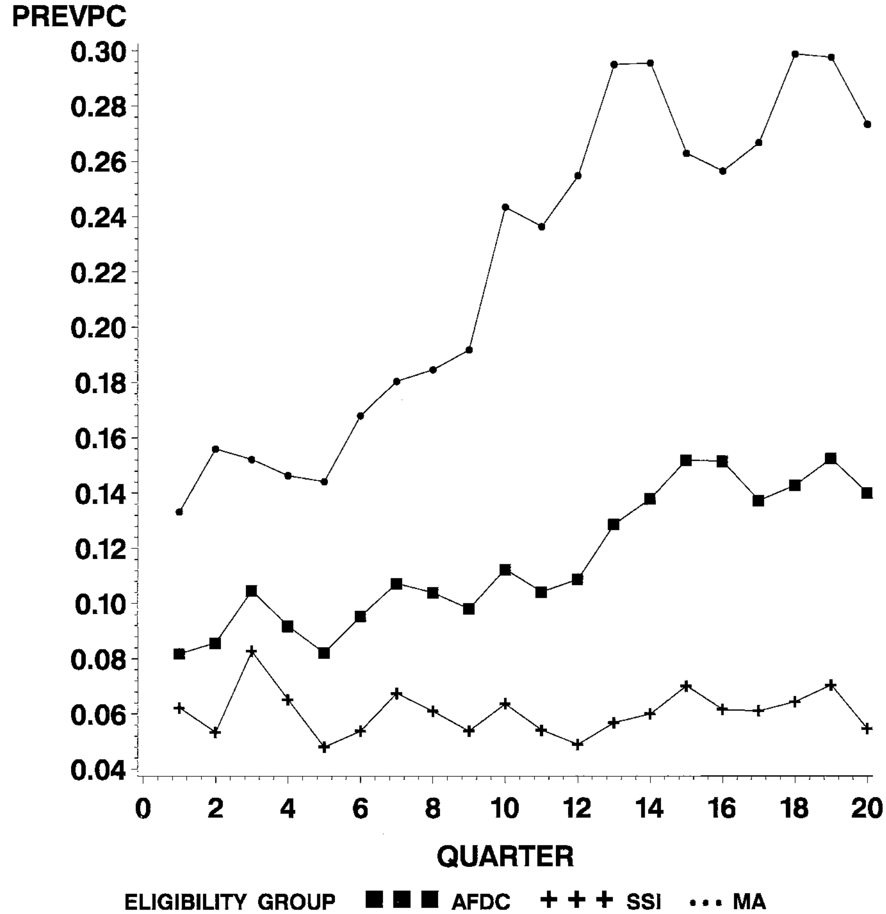

Fig 2. Per-capita preventive care visits made by MAC-eligible children during the 5-year study period, 1989 to 1993, by Medicaid eligibility group. The MAC program began at quarter 13. PREVPC, per-capita preventive care visits; AFDC, Aid to Families With Dependent Children; SSI, Supplemental Security Income; MA, Medical Assistance.

TABLE 2. Probability of Any Preventive, Emergency Department, or Ambulatory Care Determined by Logistic Regression: ORs With 95% CI (n = 3.2 Million Child-Quarters or 464 373 Children)

	Preventive (n = 383 329)	ED (n = 166 112)	Any Visit* (n = 1 145 661)
Quarter	1.00 (1.00–1.00)	0.97 (0.97–0.98)	0.98 (0.97–0.98)
Urban	1.01 (1.01–1.01)	1.01 (1.01–1.01)	1.02 (1.02–1.02)
Age	0.81 (0.81–0.81)	0.97 (0.96–0.97)	0.94 (0.94–0.94)
Male	1.00 (1.00–1.01)	0.93 (0.92–0.94)	1.04 (1.04–1.05)
White	1.09 (1.07–1.11)	1.49 (1.44–1.54)	1.07 (1.05–1.08)
Black	0.94 (0.93–0.96)	1.24 (1.20–1.28)	0.69 (0.69–0.71)
AFDC	0.81 (0.80–0.82)	1.10 (1.09–1.12)	0.93 (0.93–0.94)
SSI	0.74 (0.72–0.76)	1.44 (1.40–1.49)	1.41 (1.41–1.45)
MAC enrollment†	2.19 (2.17–2.22)	1.44 (1.42–1.46)	2.58 (2.57–2.60)

* Any visit includes preventive, primary, specialty, or ED visits.
† The MAC enrollment variable reflects enrollment on an individual level. Referent groups for gender, race and eligibility were female, races other than white or African-American, and Medical Assistance, respectively.

TABLE 3. Probability of Avoidable, ACS, or Any Hospitalization Among Children Using Any Ambulatory Care: ORs With 95% CI (n = 1.2 Million Child-Quarters)

	Avoidable (n = 6552)	ACS (n = 16 116)	Any Hospitalization* (n = 48 023)
Quarter	0.98 (0.97–0.98)	0.98 (0.97–0.98)	0.98 (0.98–0.98)
Urban	1.05 (1.04–1.05)	1.04 (1.04–1.04)	1.02 (1.01–1.01)
Age	0.95 (0.94–0.95)	0.93 (0.92–0.93)	1.04 (1.03–1.03)
Male	0.86 (0.81–0.89)	0.88 (0.86–0.91)	1.09 (1.07–1.11)
White	1.43 (1.04–1.43)	1.18 (1.07–1.30)	1.16 (1.10–1.22)
Black	1.70 (1.24–1.70)	1.35 (1.23–1.49)	1.40 (1.3–1.47)
AFDC	0.94 (0.88–1.00)	0.87 (0.84–0.91)	0.62 (0.61–0.64)
SSI	2.17 (1.93–2.43)	3.27 (3.06–3.49)	2.04 (1.97–2.12)
MAC enrollment†	0.89 (0.83–0.97)	0.96 (0.92–1.01)	0.81 (0.79–0.84)

* Any hospitalization includes avoidable or ACS as well as all other pediatric hospitalizations, except newborn, psychiatric, or long-term.
† The MAC enrollment variable reflects enrollment on an individual level. Referent groups for gender, race, and eligibility were female, races other than white or African-American, and Medical Assistance, respectively.

related to the probability of avoidable, ACS and any hospitalization. Primary care visits were associated with an increased probability of hospitalization, but to a lesser extent than ED visits.

With ambulatory visits included in the model, MAC enrollment continues to have an OR of <1 for all types of hospitalization; however, the 95% CI includes 1.0 for avoidable and ACS hospitalizations and thus MAC enrollment is of less relative importance than preventive care in affecting the probability of these hospitalizations. However, the probability of any hospitalization is lower given MAC enrollment (OR 0.82, 95% CI 0.80–0.85) despite the addition of ambulatory care visits to the model, and thus remains a significant covariate.

As children with chronic diseases use health services more, including multiple admissions, the proportion of recipients with chronic disease affects hospitalization rates.[21] With multiple hospitalizations per quarter excluded, MAC enrollment was still as-

TABLE 4. Probability of Avoidable, ACS, or Any Hospitalization Among Children Using Any Ambulatory Care: ORs With 95% CI (n = 1.2 Million Child Quarters)*

	Ambulatory Care Visits Added to the Model		
	Avoidable (n = 6552)	ACS (n = 16 116)	Any Hospitalization† (n = 48 023)
Quarter	0.99 (0.98–0.99)	0.99 (0.98–0.99)	0.99 (0.99–0.99)
Urban	1.05 (1.04–1.05)	1.04 (1.04–1.05)	1.02 (1.02–1.02)
Age	0.94 (0.94–0.94)	0.93 (0.92–0.93)	1.04 (1.03–1.03)
Male	0.88 (0.84–0.92)	0.91 (0.88–0.94)	1.10 (1.08–1.12)
White	1.10 (0.94–1.30)	1.06 (0.96–1.16)	1.07 (1.00–1.11)
Black	1.38 (1.18–1.62)	1.29 (1.17–1.42)	1.35 (1.28–1.43)
AFDC	0.88 (0.82–0.93)	0.82 (0.79–0.85)	0.60 (0.58–0.61)
SSI	1.73 (1.54–1.95)	2.81 (2.63–3.01)	1.84 (1.77–1.91)
MAC enrollment‡	0.93 (0.86–1.01)	0.98 (0.94–1.03)	0.82 (0.80–0.85)
Specialty visits	0.91 (0.90–0.93)	0.90 (0.89–0.91)	0.87 (0.86–0.87)
Primary care visits	1.11 (1.11–1.12)	1.15 (1.14–1.16)	1.20 (1.19–1.20)
Preventive visits	0.70 (0.67–0.74)	0.83 (0.80–0.85)	0.91 (0.89–0.93)
ED visits	2.11 (2.06–2.16)	2.31 (2.27–2.35)	2.13 (2.10–2.16)

* The number of ambulatory care visits was the covariate entered in the model for preventive, primary, specialty, and ED visits.
† Any hospitalization includes avoidable or ACS as well as all other pediatric hospitalizations, except newborn, psychiatric, or long-term.
‡ The MAC enrollment variable reflects enrollment on an individual level. Referent groups for gender, race, and eligibility were female, races other than white or African-American, and Medical Assistance, respectively.

sociated with a reduced probability of avoidable (OR = 0.86, 95% CI 0.80–0.94), ACS (OR = 0.93, 95% CI 0.88–0.98) and any hospitalization (OR = 0.79, 95% CI 0.76–0.81). Thus, exclusion of children with multiple hospitalizations leads to a slightly increased estimate of the impact of the MAC program on all types of hospitalization.

DISCUSSION

This study demonstrates that during MAC, per-capita ambulatory care visits, especially preventive care visits, increased, but per-capita ED visits were unchanged. Multivariate analysis supports the hypothesis that MAC enrollment on the individual level was associated with a reduced probability of avoidable hospitalization as well as other types of pediatric hospitalization. It also demonstrated a strong inverse relationship between the amount of preventive care and hospitalization. Thus, it is possible that the preventive care visits are the mechanism by which the MAC program reduces the probability of avoidable hospitalization and pediatric hospitalization overall.

Given the strong association between preventive care and reduced probability of avoidable hospitalization (OR = 0.70) documented in this study, it is likely that MAC exerts a positive effect on hospitalization through augmented preventive care, ie, numbers of preventive care visits, required EPSDT, increased access and provider continuity. A study in the 1960s demonstrated fewer hospitalizations among children enrolled in a comprehensive primary care program compared with usual medical care.[22] That preventive care decreases the need for hospitalization seems intuitive and logical, but the direct evidence to support this linkage is sparse,[23,24] particularly with respect to anticipatory guidance and periodicity of visits.[25] Most of the recommendations for childhood preventive care made by the US Preventive Services Task Force are based on insufficient evidence to support the recommendation, with the exception of childhood immunization.[26] Thus, more research is needed to document the clinical effectiveness of preventive care for children.

MAC enrollment continued to reduce the probability of hospitalization when ambulatory visits were added to the model (OR = 0.82), suggesting that the MAC program had other beneficial effects independent of increasing ambulatory care. The MAC program required EPSDT screening, promoted continuity by PMP assignment, and increased access to primary care by extending hours and days of service. The rate increase for doctors may have independently influenced the number of preventive care visits, as past studies have shown that increases in Medicaid physician fees increase the number of preventive visits as well as the continuity of care.[27] The impact of having a PMP cannot be discriminated from the impact of other MAC program elements using claims database analysis. The type of PMP is likely to be important, however the Medicaid database did not contain enough information to allow analysis of this covariate.

The lack of change in per-capita ED use during the MAC program is disappointing. The findings regarding the impact of Medicaid managed care on children's ED use have been mixed, with reductions documented in some studies,[28,29] and no change in others.[30,31] Changing ED use among children would appear to require more comprehensive measures than gatekeeping.[32]

The strengths of this study include: 1) person level data are used to predict hospitalization pre- and post-MAC, 2) ICD-9-CM codes used for avoidable hospitalization discharge diagnoses were checked for internal validity in a random sample, 3) a large database enabled the study of a low-frequency event, ie, avoidable hospitalization, 4) strict definitions of avoidable hospitalization were used and compared with broader categories, ie, ACS and all pediatric hospitalization, and 5) multivariate analysis allows for adjustment for several covariates.

ACS ICD-9-CM codes probably overclassify avoidable hospitalizations in children, and do not take into account what primary care has preceded the hospitalization. The ACS classification does include avoidable hospitalizations but also includes unavoidable hospitalizations as defined by this study (using claims data to examine prehospitalization ambulatory care). This classification also contains a large number of conditions that cannot be readily classified as avoidable or unavoidable because these conditions have not been adequately studied in children to determine how preventable these hospitalizations are. Thus, validation of ACS conditions in children is needed before these conditions can be used as indicators of access or quality of primary care among children.

Caveats of this study include that 1) it is a study of associations, not cause-and-effect, 2) limitations of administrative data apply, 3) only ambulatory or inpatient care users were included in the logistic regression, 4) individual health behavior cannot be included in the models (eg, a prescription claim is not equivalent to medication compliance), and 5) the practice of medicine is changing and, with it, the thresholds for admission to hospital.

Use of ICD-9-CM codes is always limited by physician and coding errors, which may vary by diagnosis.[33,34] Because comparisons were also made over a relatively short period of time (1989 to 1993) and were restricted to a small area (State of Maryland), coding biases should be minimal. The validation study of ICD-9-CM codes used in this study demonstrated that the ICD-9-CM discharge code was consistent with the written medical record admitting and discharge diagnosis, as has been demonstrated by other studies.[35,36] Changes in the State of Maryland revenue codes occurred coincident or preceding the MAC program. These changes may apply to preventive care, and MAC specialty care coding both of which acquired more specific codes during the MAC program. It is possible that some primary (office) visits were actually preventive visits, therefore, the number of preventive visits pre MAC could be underestimated.

Patient compliance with outpatient modalities could not be addressed in this study. For example, the fact that a Medicaid recipient received a prescription does not necessarily indicate that the medicine was taken as directed. Therefore, this study reflects the effectiveness of ambulatory measures and not their efficacy in reducing avoidable hospitalization. All avoidable hospitalizations cannot be attributed to the primary care system per se, but have individual patient-related determinants, such as disease severity, treatment compliance, health-seeking behavior. Claims analysis precludes inclusion of these covariates.

Several temporal factors complicate this study. High Medicaid recipient turnover characterizes most Medicaid programs. In this study, only 5% of Medicaid recipients were continuously enrolled during all 20 quarters. Although this group, in theory, would be more likely to demonstrate the benefits of programmatic change, subanalysis of this population is of limited generalizability. Secondly, the Medicaid expansions during the first year of MAC and the January 1993 AFDC mandate during the second year of MAC may have affected the case mix, as many new children were brought into the MAC program. Lastly, Medicaid HMOs could have exerted an adverse selection bias on the MAC program, presumably as a result of healthier Medicaid participants (typically AFDC,) selecting HMOs. The lack of HMO encounter data during this time as well as limited case mix adjustment in the Medicaid claims preclude investigation of this possibility. Therefore, the impact of the above changes cannot be measured directly and can only be indirectly modeled as temporal variables in our multivariate analysis.

It is important to note that what was considered avoidable between 1989 to 1993 is more so now because of advances in home care, managed care changes, and outpatient treatment that further reduce the need for pediatric hospitalization. Future studies will require careful application of standards of avoidable hospitalization as these will continue to change over time.

CONCLUSION

In summary, this study shows that improved primary care reduces avoidable hospitalization, a form of health care misuse that should decrease through improved access to and quality of primary care in the context of a managed care structure that promotes continuity. This finding suggests that a fee-for-service Medicaid managed care program not only improved ambulatory care but also contained costs associated with avoidable hospitalization. However, detailed cost analyses are needed to document both short-term and long-term cost effectiveness.

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APPENDIX A. Clinical Specifications For Pediatric Avoidable Hospitalizations

Condition and ICD-9-CM Code(s)	Qualifiers
Asthma (493)	Seen in ED only No ambulatory visits within 1 week of admission No steroid or adrenergic drugs dispensed as outpatient 2 weeks before hospitalization No receipt of inhalation therapy within 1 week of admission in outpatient clinic No outpatient consultant or specialist visit within 1 month
Gastroenteritis (008.4, 008.6, 008.8, 276, 558.9)	Seen in ED only Age >3 month No ambulatory visits within 1 week of admission
Diabetic ketoacidosis (250.11)	Seen in ED only No ambulatory visits within 1 week of admission No outpatient-consultant or specialist visit within 1 month
Immunizable diseases	
Measles (055)	Age >12 mo and <12 y (measles preventable by vaccination)
Pertussis (033)	Age ≥7 mo (pertussis preventable by immunization)
H influenzae infection (320.0)	Age >19 mo (*H influenzae* preventable in 1988 to 1991)
H influenzae infection (320.0)	Age ≥7 mo (*H influenzae* preventable in 1991 to 1993)
Acute otitis media (382)	Age ≥3 mo
Mastoiditis (383)	Age ≥3 mo
Upper respiratory infection (460 or 465.9)	Age ≥2 mo
Bronchitis (466.0)	Age ≥18 mo
Urinary tract infection (599.0)	Age ≥3 mo
Acute pyelonephritis (590.1-.9)	Age ≥3 mo
Pelvic inflammatory disease (614)	No antibiotic dispensed as outpatient 2 weeks before admission No ambulatory visits within 4 weeks of admission
Infant readmissions*	Infant readmitted within 2 weeks of date of birth
Jaundice (773.1, 774.2, 774.3, 774.6, 774.7)	
Volume depletion (276.0)	
Hypernatremic (276.5)	
Congenital lower bowel obstruction (751.2, 751.3, 751.4, 751.5, 560.9, 777.1)	
Obstructive cardiac defects (745.0–745.1, 746.0–746.8, 747.1–747.3)	
Nausea and vomiting (779.3, 787.0–787.03)	Age ≥3 mo
Burns (949.1–949.3)	Age between 0 and 5 y (first-degree burn in child <5 y)
Viral meningitis (047.8 and 047.90)	Age ≥2 mo
Viral syndrome (079.0)	Age ≥3 mo

* Infant readmission ICD 9-CM were developed by Lee KS, Perlman M, Ballantyne M, et al. *J Pediatr* 1995;127:758–766.

APPENDIX B. Pediatric Ambulatory Care Sensitive Conditions

Condition and ICD-9-CM Code(s)	Qualifiers
Congenital syphilis (090)	Secondary diagnosis for newborns only
Immunization preventable conditions (033, 037, 045, 320.0, 390, 391)	*Haemophilus* meningitis (320.2) for age 1–5 only
Grand mal status and other epileptic convulsions (345)	
Convulsions "A" (780.3)	Age 0–5 y
Convulsions "B" (780.3)	Age >5 y
Severe ENT infections (382, 462, 463, 465, 472.1) (20.01)	Exclude otitis media cases (382) with myringotomy with insertion of tube
Bacterial pneumonia (481, 482.2, 482.3, 482.9, 483, 485, 486)	Exclude case with secondary diagnosis of sickle cell (282.6) and patients <2 mo
Asthma (493)	
Tuberculosis (011–018)	
Cellulitis (681, 682, 683, 686)	Exclude cases with a surgical procedure (01-86.99)
Diabetes "A" (250.1, 250.2, 250.3)	
Diabetes "B" (250.8, 250.9)	
Diabetes "C" (250.0)	
Hypoglycemia (251.2)	
Gastroenteritis (558.9)	
Kidney/urinary infection (590, 599.0, 599.9)	
Dehydration-volume depletion (276.5)	
Iron deficiency anemia (280.1, 280.8, 280.9)	Ages 0–5 y only
Nutritional deficiencies (260, 261, 262, 268.0, 268.1)	
Failure to thrive (783.4)	Age <1 y

REFERENCES

1. General Accounting Office. *Medicaid: States Turn to Managed Care to Improve Access and Control Costs.* (GAO/HRD-93–46). Washington, DC: Government Printing Office; 1993
2. De Lew N. The first 30 years of Medicare and Medicaid. *JAMA.* 1995; 274:262–267
3. Newacheck PW, Hughes DC, English A, Fox HB, Perrin J, Halfon N. The effect on children of curtailing Medicaid spending. *JAMA.* 1995;274: 1468–1471
4. Cartland JDC, McManus MA, Flint SS. A decade of Medicaid in perspective: what have been the effects on children? *Pediatrics.* 1993;91: 287–295
5. Hurley RE, Freund DA, Paul JE. *Managed Care in Medicaid. Lessons for Policy and Program Design.* Ann Arbor, MI: Health Administration Press; 1993
6. Rowland D. Medicaid managed care: state experiences. *Bull N Y Acad Med.* 1996;73:496–505
7. Riley T. Medicaid. The role of the states. *JAMA.* 1995;274:267–270
8. Witek JE, Hostage JL. Medicaid managed care: problems and promise. *J Ambulatory Care Manage.* 1994;17:61–69
9. Levit KR, Lazenby HC, Cowan CA, Letsch SW. National health expenditures, 1990. *Health Care Financ Rev.* 1991;13:29–54
10. Buck JA, Klemm J. Recent trends in Medicaid expenditures. *Health Care Financ Rev.* 1992;(annu suppl):271–283
11. Billings J, Teicholz N. Uninsured patients in District of Columbia Hospitals. *Health Aff.* 1990;9:158–165
12. Institute of Medicine. Millman M, ed. *Access to Health Care in America*. Washington, DC: National Academy Press; 1993:219–221
13. Park RE, Fink AF, Brook RH, et al. Physician ratings of appropriate indications for six medical and surgical procedures. *Am J Public Health.* 1986;76:766–772
14. Leibowitz A, Buchanan JL, Mann J. A randomized trial to evaluate the effectivenss of a Medicaid HMO. *J Health Econ.* 1992;11:235–257
15. Homer CJ, Perrin JM, Kemper K, Freeman J. Effect of socioeconomic status on variation in pediatric hospitalization. *Ambulatory Child Health.* 1995;1:33–43
16. Goodman DC, Fisher Es, Gittelsohn A, Chang CH, Fleming C. Why are children hospitalized? The role of non-clinical factors in pediatric hospitalizations. *Pediatrics.* 1994;93:896–902
17. Kozak LJ, Norton C, McManus M, McCarthy E. Hospital use patterns for children in the United States, 1983 and 1984. *Pediatrics.* 1987;80: 481–490
18. Weissman JS, Gatsonis C, Epstein AM. Rates of avoidable hospitalization by insurance status in Massachusetts and Maryland. *JAMA.* 1992; 268:2388–2394
19. Perrin J, Guyer B, Lawrence JM. Health care services for children and adolescents. In: US Healthcare for Children. *Future Child.* 1992;2:58–77
20. Marquis MS, Long SH. Reconsidering the effect of Medicaid on health services use. *Health Serv Res.* 1996;30:791–808
21. Greenfield S, Nelson EC, Zubkoff M, et al. Variations in resource utilization among medical specialties and systems of care. *JAMA.* 1992; 267:1624–1630
22. Alpert JJ, Heagarty MC, Robertson L, Kosa J, Haggerty RJ. Effective use of comprehensive pediatric care: utilization of health resources. *Am J Dis Child.* 1968;116:529–533
23. Roemer MI. Primary health care and hospitalization: California and Cuba. *Am J Public Health.* 1993;83:317–318
24. Forrest CB, Simpson L, Clancy C. Child Health Services Research. *JAMA.* 1997;277:1787–1793
25. Bauchner H, Homer C, Adams W. The status of pediatric practice guidelines. *Pediatrics.* 1997;99:876–881
26. Report of the US Preventive Services Task Force. *Guide to Clinical Preventive Services.* 2nd ed. Baltimore, MD: Williams & Wilkins; 1996
27. Cohen JW, Cunningham PJ. Medicaid physician fee levels and children's access to care. *Health Aff.* 1995;14:255–262
28. Bonham GS, Barber GM. Use of health care before and during Citicare. *Med Care.* 1987;25:111–119
29. Hurley RE, Freund Da, Taylor DE. Emergency room use and primary care case management: evidence from four Medicaid demonstration programs. *Am J Public Health.* 1989;79:843–847
30. Glotzer D. Sager A, Socolar D, Weitzman M. Prior approval in the pediatric emergency room. *Pediatrics.* 1992;88:674–680
31. Mauldon J, Leibowitz A, Buchanan JL, Damberg C, McGuigan KA. Rationing or rationalizing children's medical care: comparison of a Medicaid HMO with fee-for-service care. *Am J Public Health.* 1994;84: 899–904
32. Gadomski AM, Perkis V, Horton L, Cross S, Stanton B. Diverting managed care Medicaid patients from pediatric emergency department use. *Pediatrics.* 1995;95:170–178
33. Lloyd SS, Rissing JP. Physician coding errors in patient records. *JAMA.* 1985;254:1330–1336
34. Smith MW. Hospital discharge diagnoses: how accurate are they and their international classification of disease (ICD) codes. *N Z Med J.* 1989;102:507–508
35. Malenka DJ, McLerran D, Roos N, Fisher ES, Wenneberg JE. Using administrative data to describe casemix: a comparison with the Medical Record. *J Clin Epidemiol.* 1994;47:1027–1032
36. Quam L, Ellis L, Venus P, Clouse J, Taylor CG, Leatherman S. Using claims data for epidemiologic research. *Med Care.* 1993;31:498–507

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