

Early and Periodic Screening, Diagnosis, and Treatment and Infant Health Outcomes in Medicaid-Insured Infants in South Carolina

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Objectives To test the hypothesis that infants experiencing the recommended number of early and periodic screening, diagnosis, and treatment (EPSDT) visits have better health outcomes than infants with fewer visits.

Study design Data represent all health encounters for Medicaid-insured infants of mothers aged at least 18 years in South Carolina, from 2000 to 2002, who were continuously enrolled in fee-for-service insurance (n = 36,662). We examined associations between having at least the recommended number of visits in the first year and health care use in the second year: sick infant doctor visits, emergency department (ED) visits, hospital admissions, and hospitalizations and ED visits for ambulatory care sensitive conditions.

Results Infants with at least the recommended number of EPSDT visits had a higher adjusted rate of sick infant doctor visits (rate ratio, 1.49; 95% CI, 1.41-1.58), but a lower adjusted rate of ED visits for ambulatory care sensitive conditions (rate ratio, 0.94; 95% CI, 0.89-0.99). Having at least the recommended preventive visits did not affect rates of general ED visits or of hospitalizations.

Conclusions Having at least the recommended number of EPSDT visits may shift some health provision from the ED to physicians' offices. (*J Pediatr* 2007;151:414-8)

The early and periodic screening, diagnosis, and treatment (EPSDT) benefit, added to Medicaid in 1967, was designed to prevent disease in children and to detect and treat health problems before they become more serious.¹⁻³ The American Academy of Pediatrics (AAP) recommends 6 EPSDT visits in the first year of life and 3 in the second year of life.^{4,5} The effects of fulfilling these recommendations has been minimally evaluated.⁵⁻¹² The AAP recommendations were based on consensus expert opinion about preventive care and immunization schedules.⁹ Thus, empirical investigations of the recommendations are useful.

One study has found that being up-to-date on EPSDT visits reduced hospitalization,⁶ although few infants in that study received the recommended number of visits. Two randomized clinical studies compared infants receiving differing numbers of EPSDT visits. One compared infants with 6 visits in the first year of life to infants having only 3 visits in the first year of life, finding little difference in process-of-care measures such as maternal satisfaction with care.¹⁰ That study did not examine objective measures of infant health. The second study compared infants averaging 7.6 visits in the first 2 years of life with infants averaging 4.8 visits in the first 2 years of life, finding no meaningful differences in infant outcomes.¹¹ That study did not explicitly examine effects of receiving the AAP recommended number of EPSDT visits, which is a policy-relevant question that has not been adequately addressed.

Our hypothesis was that infants having at least the recommended number of EPSDT visits in the first year of life should have better health in the second year than infants with fewer visits. Infants with at least the recommended number of visits should have fewer hospitalizations and emergency department (ED) visits in their second year.

A category of hospitalization and ED visits that may be especially likely to be reduced by having the recommended number of EPSDT visits is hospitalization and ED

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AAP	American Academy of Pediatrics	HCPCS/CPT	Health Care Financing Administration
ACSC	Ambulatory care sensitive condition		Common Procedure Coding System
ED	Emergency department		published in the Physician's Current
EPSDT	Early and periodic screening, diagnosis, and treatment	ORS	Procedural Terminology
FFS	Fee-for-service		Office of Research and Statistics of the South Carolina Budget and Control Board

visits for ambulatory care sensitive conditions (ACSCs). These include asthma; seizure; cellulitis; ear, nose, and throat infections; bacterial pneumonia; kidney/urinary tract infections; and gastrointestinal infections. The education and treatments provided during EPSDT visits should help to avoid exacerbations of ACSCs and should also help mothers to better understand circumstances that require a physician office visit. Thus, we expect that rates of ACSC hospitalization and ED visits will be lower for infants receiving at least the recommended number of EPSDT visits. Mothers who establish relationships with their infants' health care providers through regular EPSDT visits may be more likely to use sick infant doctor visits, rather than waiting until an ACSC requires emergency care or hospitalization. Thus, having more EPSDT visits in the first year may increase sick infant doctor visits in the second year. If this increase is associated with fewer hospitalizations or ED visits, the increase in sick infant doctor visits would not cause us to reject the hypothesis of improved health in the second year.

METHODS

Population Studied

We studied South Carolina infants born in 2000, 2001, or 2002 and continuously enrolled in fee-for-service (FFS) Medicaid in their first 2 years of life ($n = 36,662$). Data were obtained from linked state Medicaid claims and birth certificate files, obtained from the South Carolina Budget and Control Board, Office of Research and Statistics (ORS). This study was approved by the institutional review board of the Medical University of South Carolina and the South Carolina Data Oversight Commission, which supervises the use of ORS data. Because the infant's mother primarily determines infant health care use, and mothers <18 years old deal with unique risks for use, we focused on infants with mothers at least 18 years old at delivery.¹³⁻¹⁵ Our earlier research with the South Carolina Medicaid data suggests that the data and linkages required for this research have a high degree of completeness and validity.¹⁵

Dependent Variables

Dependent variables to be analyzed in separate models include the number of: sick infant doctor visits, ED visits, hospital admissions, and both ED visits and hospital stays specifically for ACSCs for study infants during their second year of life. The specific diagnoses monitored for sick infant doctor visits, and also for hospitalizations and ED visits for ACSCs, are those previously reported to be the most common ACSC diagnoses recorded for infants insured by Medicaid in ED and hospital settings.¹⁶

Exposure Variable

The exposure variable, or independent variable of primary interest, was EPSDT visits. These visits were dichotomized, indicating infants receiving at least the AAP-recommended number of visits in the first year or fewer. EPSDT

visits were identified by using the Health Care Financing Administration Common Procedure Coding System codes and definitions published in the Physician's Current Procedural Terminology (HCPCS/CPT).¹⁷

Control Variables

Control variables included characteristics of mothers: age in years; education in years; and dummy variables indicating whether the woman was married; whether the woman was non-Hispanic white, African American, Hispanic, another race or ethnicity, or had a missing value for race/ethnicity; rural or urban residence; family income $\leq 50\%$ of the Federal poverty threshold, or greater income (as high as 185% of poverty in South Carolina Medicaid); nulliparous mothers; whether the woman smoked, drank alcohol, or used illicit drugs during pregnancy; and whether the woman received adequate prenatal care, as defined by the Kessner Index of Prenatal Care Adequacy.^{18,19} Also included in the model were controls for infant sex and gestational age. Earlier studies have shown that these maternal and infant characteristics are often associated with infant health.¹⁵ We control for them in the multivariate analysis to isolate the effect of having at least the recommended number of EPSDT visits.

The study excluded infants with birth admissions lasting ≥ 7 days or with major congenital anomalies, including sickle cell anemia.²⁰⁻²² Infants were also restricted to those who were full term and appropriately grown at birth, by requiring at least 37 weeks gestational age and infant birth weight within fetal growth norms.^{23,24} We also restricted the study to infants consistently enrolled in FFS in the second through the 24th months of life. (Some infants in South Carolina Medicaid are not enrolled until sometime during the first month.) FFS enrolls most infants in the state's Medicaid program, 96.6% during the study period. A total of 1534 infants who switched health care models during the study period were excluded (3.5% of the sample).

Analytical Approach

Bivariate analyses compared characteristics of mothers and infants in 2 groups, those having the recommended EPSDT visits and others (χ^2 for categorical data; t tests for continuous measures). Multivariate analyses assessed the effects of having at least the recommended number of EPSDT visits in the first year of life, for each dependent variable, adjusted for relevant characteristics of the mothers and infants.

Because the count data in the analysis exhibited over-dispersion, negative binomial regression was used to estimate the models. Over-dispersion occurs when the variance of the dependent variable notably exceeds its mean. This data characteristic can seriously challenge the analysis of count data, such as those that are the focus of our analysis. When present, over-dispersion can produce underestimates of standard errors, leading to faulty conclusions about statistical significance. Negative binomial regression corrects the standard

Table I. Bivariate comparisons of maternal and infant characteristics by recommended early and periodic screening, diagnosis, and treatment visit status, South Carolina Medicaid, years 2000 to 2002*

	Received fewer than recommended number of EPSDT visits in year 1 (n = 32,593)	Received at least recommended number of EPSDT visits in year 1 (n = 4069)	P value
Mothers' characteristics			
Age in years, mean (SD)	24.3 (5.1)	24.2 (5.3)	.439
Education in years, mean (SD)	11.7 (2.0)	12.0 (2.0)	<.001
Married, n (%)	6543 (20.1)	850 (20.9)	.222
Maternal parity, nulliparous, n (%)	10,992 (33.8)	1889 (46.4)	<.001
Race white, n (%)	11,640 (35.7)	1827 (44.9)	<.001
Race African American, n (%)	17,643 (54.1)	1875 (46.1)	<.001
Race Hispanic, n (%)	2105 (6.5)	213 (5.2)	.002
Race other, n (%)	207 (0.6)	29 (0.6)	.875
Race unknown, n (%)	998 (3.1)	141 (3.2)	.706
Urban resident, n (%)	20,071 (61.6)	2950 (72.5)	<.001
Family income ≤50% of poverty, n (%)	8515 (26.1)	904 (22.2)	<.001
Prenatal visits, mean (SD)	12.3 (9.6)	12.5 (8.3)	<.001
Adequate prenatal care, n (%)	19,937 (63.7)	3099 (65.4)	<.001
Used alcohol while pregnant, n (%)	219 (0.7)	33 (0.8)	.312
Used tobacco while pregnant, n (%)	5523 (17.0)	711 (17.5)	.402
Used illicit drugs while pregnant, n (%)	695 (2.1)	80 (2.0)	.568
Infant care and characteristics			
EPSDT visits, year 1, mean (SD)	3.5 (1.5)	6.4 (0.9)	<.001
EPSDT visits, year 2, mean (SD)	1.7 (1.2)	2.5 (1.2)	.003
Male sex, n (%)	16,273 (49.9)	2028 (49.9)	.916
Gestational age, mean (SD)	39.1 (1.1)	39.1 (1.7)	.001

errors. Multicollinearity was assessed and was not a problem for any of the analyses. STATA statistical software (College Station, TX) was used for all analyses.

RESULTS

Table I shows bivariate comparisons of maternal and infant characteristics, comparing those having at least the recommended number of EPSDT visits to those having fewer. Mothers of infants having at least the recommended number of visits were slightly better educated (12.0 years compared with 11.7, $P < .001$). They were also more likely to be white, be urban residents, have adequate prenatal care, and be nulliparous. Infants having fewer than the recommended number of EPSDT visits had considerably fewer than the recommended 6 visits, with an average of 3.5. Only 11% of the total sample received at least the recommended number of EPSDT visits in the first year.

For each measured outcome, such as sick infant doctor visits, Table II shows the adjusted rate ratios; the rates for those with at least the recommended EPSDT visits are the numerators. Rate ratios <1.00 suggest that infants having at least the recommended number of EPSDT visits had less use of the given outcome. For each rate ratio estimate, Table II also presents the lower and upper bounds of the 95% CI. Infants with the recommended EPSDT visits were 49% more likely to have sick infant doctor visits (95% CI, 1.41-1.58) and 6% less likely to have ED visits for ACSCs (95% CI, 0.89-0.99). There were no discernable differences in ED use more generally or for hospital admissions.

DISCUSSION

Consistent with our hypothesis, having at least the recommended number of EPSDT visits was associated with a lower adjusted rate of ED visits for ACSCs and a higher adjusted rate of sick infant doctor visits. One plausible explanation for this result is that mothers of infants with at least the recommended number of EPSDT visits may be more likely to bring sick infants to the doctor's office, rather than to the ED. This would be a desirable outcome of fulfilling the recommended number of EPSDT visits.

Are these results clinically important? The rate of sick infant doctor visits was 49% greater in infants with at least the recommended EPSDT visits. This is clearly clinically significant. Infants having at least the recommended number of EPSDT visits also had 6% fewer ED visits for ACSCs. It seems likely that most state Medicaid offices would consider reducing the occurrence of this costly and potentially preventable medical service by 6% to be useful.

Several factors should be considered when evaluating these results. Evidence documenting that the recommended number of EPSDT evaluations represents an optimal number is limited.^{2,6,8,25} Using Medicaid claims for documenting EPSDT use and other provider service use may underestimate the true amount of services received.^{2,26} The data did not provide details about the specific care received by infants during EPSDT visits or in visits not designated as EPSDT. It is possible that EPSDT services were provided in some portion of the latter visits. Also, EPSDT visits are characterized

Table II. Adjusted rate ratios comparing health care use in year 2 for infants receiving the AAP recommended number of early and periodic screening, diagnosis, and treatment visits in year 1 to infants receiving fewer than the AAP recommended number of visits in year 1, South Carolina Medicaid, years 2000 to 2002*

	Had at least the recommended number of EPSDT visits in year 1 (numerator), compared with having fewer visits (denominator)†		
	Rate ratio	95% CI	
Year 2 outcomes			
Sick infant doctor visits	1.49	1.41	1.58
ED visits	0.98	0.94	1.02
Hospital admissions	1.01	0.94	1.09
ACSC ED visits	0.94	0.89	0.99
ACSC hospital admissions	1.11	0.94	1.32

*Data source: South Carolina Office of Research and Statistics, representing all infants enrolled in FFS Medicaid with mothers aged at least 18 years.

†Results of a negative binomial regression model adjusted for maternal age, education, marital status, parity, race, urban/rural residence, income, adequacy of prenatal care, and use of alcohol, tobacco, or illicit drugs during pregnancy, and also for infant sex and gestational age; reference category in each model is infants who did not receive at least the recommended number of EPSDT visits.

by loosely standardized procedures. EPSDT evaluations for infants of the same age may differ among providers. Results of a nationally representative survey of parents suggest that there are substantial gaps between the recommended content of well-child care and what parents report is actually provided.²⁷ If the provision of services or practices of filing claims differed systematically in physicians treating infants with differing numbers of recorded EPSDT visits, these effects may have biased the results.

The AAP recommends a schedule for well-child visits for EPSDT evaluations, at age-based intervals.⁶ This research did not examine whether adhering to that schedule had an impact on the measured outcomes. It is possible that some portion of the results may be attributable to the timing of visits received, rather than to their number. Also, it is possible that health benefits of receiving at least the recommended number of EPSDT visits continue to accrue after the second year of life. Our data and analysis did not address this possibility.

Our data did not permit us to identify whether the reduced use of ED visits for ACSCs was caused by better health in infants having at least the recommended number of EPSDT visits or to a shifting of treatment from EDs to sick infant doctor visits. What we do know from these results is that infants having at least the recommended EPSDT visits used fewer ED visits for ACSCs. Regardless of what this may reveal about health status, this result may produce savings for Medicaid.

The outcomes studied were uses of illness-related health services. Determinants of use can include: underlying illness severity; the accessibility, effectiveness, and use of preventive services; provider characteristics such as willingness to refer to the ED or to hospitalize or thresholds of illness at which hospitalization is advised; and payer characteristics such as incentives to use preventive services or disincentives to use the ED or to hospitalize. We used multivariate analysis to account for infants' and mothers' characteristics associated with many of these determinants. However, it is likely that some of these determinants were imperfectly adjusted by the measured covariates. A more important issue is that our study did not control for provider characteristics. If providers who fulfill the AAP guidelines differ systematically from providers who do not in their propensity to suggest use of the ED, for example, then this difference may have affected the results. It is possible that the effects we found result from provider characteristics, rather than from effects of EPSDT.

This was an observational study that could not randomize subjects. Results may be affected by selection bias. This possibility was to some extent addressed by using multivariate regression analysis, which adjusted for previously identified confounding factors such as maternal age, education, parity, and income. However, because subjects were not randomly assigned into study groups, the results cannot establish causation. The study excluded infants born to mothers aged <18 years, 12% of all births to women covered by Medicaid. The results may not apply to infants born to young mothers. Fewer than 4% of infants switched health care models during the study period and were excluded from the analysis. It is possible that the infants excluded had different characteristics than those included, a factor that might bias the results; this concern is ameliorated to a considerable degree by the relatively small proportion of exclusions.

Only 11% of infants received at least the recommended number of EPSDT visits. This low rate is consistent with EPSDT performance in Medicaid found in other studies,^{5,28,29} even after the Omnibus Budget Reconciliation Act of 1989 attempted to enhance EPSDT access for children insured by Medicaid.⁷ We hypothesized that infants having at least the recommended number of EPSDT visits would have better health and that this better health would be evident in health care use. We did not observe differences in the groups in general ED visits or in rates of hospitalization. However, sick infant doctor visits were considerably more frequent in infants having the recommended preventive care. Although this result was accompanied by modestly lower use of ED visits, sick infant doctor visits also entail costs. Thus, the results do not provide strong evidence for increasing the proportion of infants having the recommended number of EPSDT visits in FFS Medicaid. However, it is likely that many health policy analysts may consider a shift of services from the ED to physicians' offices to be a useful outcome for the Medicaid system.

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