Objective: To evaluate trends in childhood immunization coverage after implementation of Medicaid managed care in Tennessee (TennCare) in 1994.

Design: Before-and-after study using the Tennessee Department of Health annual cross-sectional survey of children aged 24 months.

Patients: A mean of 1663 children per year who were randomly sampled during 1986-1999.

Main Outcome Measure: Completion rate for recommended immunizations by the age of 24 months or younger.

Results: A total of 23044 children were included. The proportion of children continuously enrolled in Medicaid from age 1 to 24 months increased slightly with TennCare. Among children enrolled, immunization rates increased considerably before TennCare (1986-1993) and continued to increase after TennCare (1994-1999), albeit less dramatically. Immunization coverage was significantly lower for children enrolled compared with children not enrolled in fee-for-service Medicaid. Among children enrolled in fee-for-service Medicaid, black children were more likely to be inadequately immunized than white children (40% vs 26%; relative risk [RR], 1.56; 95% confidence interval [CI], 1.40-1.73). These gaps were nearly eliminated after TennCare. An increased proportion of children enrolled in TennCare received immunizations in the private sector. Among children enrolled in fee-for-service Medicaid, those receiving immunizations entirely in the private sector were more likely to have incomplete immunization status than children immunized entirely in the public sector (27% vs 21%; RR, 1.28; 95% CI, 1.20-1.37). Under TennCare and after implementation of the Vaccines for Children program in Tennessee, the difference was not significant.

Conclusions: Overall, TennCare had no discernible negative effect on immunization rates in Tennessee and perhaps contributed to decreasing the immunization gap between children enrolled and children not enrolled in Medicaid and between black and white children.
A national objective of Healthy People 2010 is to reduce or eliminate indigenous cases of vaccine-preventable diseases through increased vaccination coverage. Monitoring of immunization rates at individual clinics or for individual physicians has been suggested as an important feedback mechanism for improving performance. Under TennCare contract, MCOs are required to submit data regarding compliance with the federal Early and Periodic Screening, Diagnosis, and Treatment Program, which mandates that children receive immunizations according to the schedule recommended by the Advisory Committee on Immunization Practices.

To our knowledge, no large, quantitative investigation of the impact of TennCare on childhood immunization rates has been published. Since 1983, the Tennessee Department of Health has conducted an annual cross-sectional survey of children aged 24 months to estimate childhood immunization coverage. We used this large, unique database to evaluate trends in childhood immunizations before and after the implementation of TennCare to examine the effect of Medicaid managed care and the influence of race and immunization provider type on immunization rates.

METHODS

DESIGN AND STUDY POPULATION

This is a before-and-after study of the impact of TennCare on immunization rates using the Tennessee Department of Health’s annual Survey of the Immunization Status of 24-Month-Old Children for children born during 1986-1999. The survey has been performed annually since 1983 and is a random sample selected from the birth certificates of all children born in Tennessee exactly 2 years earlier. Each year’s sample represents approximately 30% of all births in the state during the sample month. The sample size of births selected from each of 13 health department regions was determined based on a standard population size formula, including corrections to account for expected exclusions, such as migration out of state. Survey completion rates (response rates) could be calculated for the last 6 surveys included in the study (birth years 1994-1999); the average response rate was 88.4% (range, 77.2%-93.4%). Each health department region conducts a search for the immunization records for children in the sample, beginning with the Tennessee Immunization Registry. If the registry does not show that age-appropriate immunizations are complete, then the parents are interviewed to get a list of all possible immunization providers; all immunization providers are contacted in the search for immunization records. Only official written provider records or data from the computerized Tennessee Immunization Registry are accepted as valid.

VARIABLES

Immunization status and selected other data, including race, Medicaid enrollment status (fee-for-service Medicaid or TennCare), and immunization provider type, were included in the database. Immunization provider type was defined as either public sector (health department clinic) or private sector (all other providers). Assessment of immunization status was based on completion of the basic 4:3:1 series as developed and recommended by the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, the American Academy of Family Physicians, and the Food and Drug Administration.

The 4:3:1 series includes 4 doses of a diphtheria-tetanus-pertussis vaccine, 3 doses of poliovirus vaccine (oral poliovirus vaccine or inactivated poliovirus vaccine), and 1 dose of measles-mumps-rubella vaccine. Completion rates represent the proportion of children who received all immunizations in the series by the age of 24 months. Because immunization against hepatitis B virus, varicella zoster virus, Haemophilus influenzae type b, and Streptococcus pneumoniae were not routinely administered to children during the entire study period, they were not included.

DATA ANALYSIS

Rates for completion of the 4:3:1 series were determined based on Medicaid enrollment status (fee-for-service Medicaid for each birth cohort in 1986-1993 and TennCare for each birth cohort in 1994-1999). To be considered enrolled in fee-for-service Medicaid or TennCare, a child must have had continuous enrollment from the age of 30 days through 24 months. Immunization completion rates of children enrolled in Medicaid were compared with the immunization rates of children in the survey who were never enrolled. Bivariate statistical analyses were performed using χ² tests calculated with Epi Info 2002 software. Multivariate logistic regression was used to examine the effect of enrollment status, provider type, and race on immunization status before and after TennCare.

A total of 1 123 304 resident live births were recorded in Tennessee during the period 1986-1999; 23044 children (2.1%) were included in the study (mean, 1663 children per year). The proportion of children continuously enrolled in Medicaid increased from 21% for fee-for-service Medicaid (1986-1993 birth cohorts) to 34% under TennCare (1994-1999 birth cohorts) (P<.001). Among children enrolled in fee-for-service Medicaid or TennCare, the proportion of white children increased during the study period (from 41% to 67%), with a corresponding decrease in the proportion of black children (from 59% to 32%). The proportion of children enrolled in fee-for-service Medicaid or TennCare receiving all of their immunizations in the private sector increased during the study period from 32% for the 1986-1993 birth cohorts to 44% under TennCare (P<.001) (Figure 1). Use of private providers for immunizations increased for each of the first 6 cohorts of children born under TennCare (1994-1999), and 77% of children born in 1999 received at least some of their immunizations in the private sector. A corresponding decrease in the proportion of children receiving immunizations in the public sector occurred.

The proportion of children completing the 4:3:1 series increased considerably for all children born during 1986-1993 (Figure 2). Children who were enrolled in fee-for-service Medicaid had lower immunization completion rates but showed a substantial increase, whereas children not enrolled in Medicaid had higher rates and a more gradual increase during that period. The gap in completion rates between children enrolled and children not enrolled was reduced from 11% before TennCare to 4% after TennCare (P<.001). Immunization completion rates continued to increase, albeit less significantly, for both
the TennCare and non-TennCare cohorts of children born during 1994-1999.

Among children enrolled in fee-for-service Medicaid (Figure 3), black children were more likely to be inadequately immunized at 24 months than white children (40% vs 26%; relative risk [RR], 1.56; 95% confidence interval [CI], 1.40-1.73). Among children enrolled in TennCare, the gap between completion rates for white children and black children markedly decreased (Figure 3); black race became a marginal risk factor for not completing the 4:3:1 series (17% vs 14%; RR, 1.25; 95% CI, 1.04-1.49).

We examined the impact of Medicaid enrollment status, provider type, and race on all children before and after TennCare in 2 multivariate analyses. During both periods, children continuously enrolled in Medicaid were more likely to have incomplete immunization status than children immunized entirely in the private sector (27% vs 21%; RR, 1.28; 95% CI, 1.20-1.37). After TennCare, enrolled children immunized in the private sector were still slightly more likely to be incomplete, but the difference was not significant (RR, 1.04; 95% CI, 0.93-1.18).

Among children enrolled in fee-for-service Medicaid, those receiving immunizations entirely in the private sector were more likely to have incomplete immunization status than children immunized entirely in the public sector (27% vs 21%; RR, 1.28; 95% CI, 1.20-1.37). After TennCare, enrolled children immunized in the private sector were still slightly more likely to be incomplete, but the difference was not significant (RR, 1.04; 95% CI, 0.93-1.18).

We examined the impact of Medicaid enrollment status, provider type, and race on all children before and after TennCare in 2 multivariate analyses. During both periods, children continuously enrolled in Medicaid were more likely to have incomplete immunization status than children with no Medicaid enrollment, although this effect

Figure 1. Immunization provider(s) for children continuously enrolled in fee-for-service Medicaid or TennCare (a statewide Medicaid managed care plan in Tennessee) by birth year. The proportion of children receiving all immunizations in the private sector or immunization in both the public and private sectors increased during the study period, with a corresponding decrease in public sector immunizations.

Figure 2. Rates of completion of the 4:3:1 immunization series by enrollment status in fee-for-service Medicaid or TennCare (a statewide Medicaid managed care plan in Tennessee) by birth year. The arrow represents the year TennCare was implemented.

Figure 3. Rates of completion of the 4:3:1 immunization series by race for children continuously enrolled in fee-for-service Medicaid or TennCare (a statewide Medicaid managed care plan in Tennessee) by birth year. The arrow represents the year TennCare was implemented.
was not as strong after TennCare (Table). Children immunized entirely in the private sector were more likely to be inadequately immunized than children immunized entirely in the public sector, but the difference was minimal after TennCare. Before TennCare, black children were more likely to have incomplete immunization status, whereas differences between black and white children after TennCare were diminished and were only marginally significant (Table).

### COMMENT

The Tennessee Department of Health’s annual immunization survey of children aged 24 months is distinctive. Implemented in 1988, it is a birth certificate–derived sample designed to be representative of all 13 health department regions within the state. The immunization history of each child in the survey is documented by either provider records or the statewide immunization registry. The consistency of methods of this immunization survey allows for comparison over time.

Despite the abrupt transition to Medicaid managed care in Tennessee and consequent concerns regarding the impact on health care quality, this study documented that immunization completion rates for the 4:3:1 series continued to increase after the implementation of TennCare. This finding is consistent with several studies of immunization rates under Medicaid managed care in other states, which demonstrated no difference compared with traditional fee-for-service Medicaid. Studies of other health care quality indicators for TennCare demonstrated either no change or improvement in outcomes following the implementation of TennCare. Indeed, the longstanding gap between immunization rates of children enrolled and children not enrolled in Medicaid was nearly eliminated after TennCare.

However, several important developments were occurring concurrent with the implementation of TennCare that might have affected immunization rates. The measles epidemic in the early 1990s created increased public interest in improving immunization coverage. The national Childhood Immunization Initiative began in 1993 and aimed to improve the quality and quantity of vaccine delivery, reduce vaccine cost, and increase community participation and education. Also in 1993, the standards for Pediatric Immunization Practices were published and widely endorsed. In addition, it has been suggested that the media coverage surrounding the implementation of TennCare and advertising by MCOs might have increased awareness of the importance of preventive services for children. The extent that these factors contributed to increasing immunization rates under TennCare cannot be determined.

In addition to events occurring on the national level, the Tennessee Department of Health implemented several initiatives since 1994 in an effort to improve immunization coverage. These initiatives included a statewide immunization registry and a reminder card system, which likely had a positive effect on immunization rates. Also, a voucher incentive program was started for children enrolled in the Special Supplemental Food Program for Women, Infants, and Children (WIC), which allowed families whose children were up to date with their immunizations to receive 3 months’ worth of food vouchers instead of just 1 month. However, despite all these initiatives, immunization rates increased more slowly after 1994 for both children enrolled and children not enrolled in TennCare. As immunization rates approach the elusive Healthy People 2000 goal of 90%, increasing immunization rates the last several percentage points toward this goal might require innovative strategies and an increased amount of energy and resources.

We documented several important demographic changes that occurred with TennCare. Although the proportion of children continuously enrolled in Medicaid from age 1 to 24 months increased in the early 1990s, coinciding with changes in Medicaid eligibility criteria, a further increase was noted after the implementation of TennCare. This finding is consistent with another study, which reported that fewer children had gaps in coverage during the first year of life under TennCare.

An increasing proportion of children received immunizations in the private sector under TennCare, with a corresponding decrease in children immunized in the public sector. The effect of this shift on immunization rates would depend on a difference in performance between the public and private providers. Although some studies suggest an advantage to receiving immunizations in the private sector, others suggest the opposite. Another study concluded that having a medical home was
We examined the effects of an abrupt, statewide shift from fee-for-service Medicaid to Medicaid managed care (TennCare). We performed a before-and-after study using a statewide immunization survey with longitudinal data spanning 14 years. The transition to TennCare was accompanied by a large increase in the proportion of children immunized in the private sector. As has been suggested by other studies, TennCare had no discernible negative effect on immunization rates. Furthermore, TennCare might have contributed to decreasing the immunization gap between children enrolled and children not enrolled in Medicaid and between black and white children.

not associated with up-to-date immunization status. In our study, immunization completion rates for the 4:3:1 series for children immunized in the private sector were lower overall than for children immunized in the public sector, although the difference was minimal after TennCare.

An additional factor that might have contributed to the continued increase in immunization rates after TennCare, especially in the private sector, was the development of the federal Vaccines for Children (VFC) program. The VFC program was part of the 1993 Childhood Immunization Initiative but was not widely implemented in Tennessee until 1996. This program provided free vaccines for children who were Medicaid eligible, partly in response to studies that showed cost to be a barrier to immunization of children in private physician’s offices, despite Medicaid insurance. Many of these children left their physician’s office without being immunized, which represented a missed opportunity. Because of the trend toward immunization in the private sector under TennCare, a sustained negative effect might have been predicted. However, for TennCare children born after 1995, immunization rates in the private sector improved, coincident with the widespread implementation of the VFC program.

Nationwide disparities in childhood immunization coverage persist in the United States, with black children having lower rates than white children. Lack of access to primary care and missed opportunities to vaccinate have been blamed. Although black race remained a risk factor for delayed or incomplete immunization in Tennessee, the gap between immunization rates for black and white children decreased significantly after 1994. TennCare’s efforts to increase access to primary care might have contributed to this decrease in disparities. However, some or all of the credit might belong to other factors, such as the VFC program, which aimed to decrease missed opportunities due to financial barriers during health care visits.

Limitations of this study of the effect of TennCare on immunization rates include the unknown effect of other immunization initiatives on immunization rates during the study period. These initiatives included the VFC program, the Special Supplemental Food Program for Women, Infants, and Children (WIC) voucher incen-

tive program, the Tennessee Immunization Registry, and other Tennessee Department of Health programs.

Overall, TennCare had no discernible negative effect on immunization rates in Tennessee and perhaps contributed to decreasing the immunization gap that existed between children enrolled in fee-for-service Medicaid and children not enrolled and between black and white children. However, these improvements might have been the result, in part or in whole, of national and local initiatives unrelated to TennCare, which likely influenced immunization rates. As immunization rates approach the Healthy People 2000 goal of 90%, further progress toward that goal might require an increase in effort and expenditures.

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