Changes in Continuity of Enrollment Among High-Risk Children Following Implementation of TennCare

William O. Cooper, MD, MPH; Gerald B. Hickson, MD; Clinton L. Gray; Wayne A. Ray, PhD

**Background:** TennCare, Tennessee's Medicaid managed care program, was introduced in 1994 with the goals of controlling spending and of improving access to health care.

**Objective:** To assess changes in the continuity of enrollment following the implementation of TennCare for 2 groups: infants in the first year of life (defined as persons aged 0-12 months in this study) and children hospitalized with a chronic health condition (defined as persons aged 0-18 years in this study).

**Design:** Retrospective cohort analysis.

**Setting and Population:** Infants born during 1992 or 1995 to women enrolled in Medicaid or TennCare and 0- to 18-year-old children enrolled in Medicaid or TennCare who were discharged from a hospital during 1992 or 1995 with a chronic health condition.

**Main Outcome Measures:** For infants, failure to enroll an infant in the first 30 days of life or subsequent gaps in enrollment for 7 days or longer during the first year of life. For children hospitalized with a chronic health condition, any gap in enrollment lasting 7 days or longer by 1 year after discharge from a hospital.

**Results:** There was a reduction in the proportion of infants without continuous enrollment in the first year of life following TennCare (19.4% after vs 25.1% before TennCare; odds ratio, 0.69; 95% confidence interval, 0.67-0.72). Improvements in continuity of enrollment for infants occurred despite an increase in the proportion of infants who were not enrolled in TennCare in the first 30 days of life, even though their mother was enrolled at delivery (14.0% after vs 8.0% before TennCare; odds ratio, 1.86; 95% confidence interval, 1.78-1.96). There was a decrease in the proportion of children hospitalized with a chronic health condition who had subsequent gaps in enrollment by 1 year following discharge from a hospital (14.3% after vs 23.3% before TennCare; odds ratio, 0.52; 95% confidence interval, 0.46-0.59).

**Conclusion:** For infants in the first year of life and for children hospitalized with a chronic health condition, implementation of TennCare improved continuity of coverage.


---

**Editor's Note:** Provide it, and they will come.

*Catherine D. DeAngelis, MD*

FINANCIAL BARRIERS to health care access, including lack of health insurance, may deter individuals from receiving care and thus may threaten health outcomes. This is especially true for children, who have unique patterns of illness and are at particularly high risk for health problems associated with poverty. Medicaid has traditionally provided health insurance coverage for poor children and adults, but rapidly increasing health care costs have led states to seek ways to reduce health care expenditures.
PATIENTS AND METHODS

STATE AND PROGRAM CONTEXT

TennCare was implemented in 1994 as a significant revamping of Tennessee’s Medicaid program under the federal government’s section 1115 waiver program. TennCare involved enrolling almost all Medicaid enrollees in managed care and expanding the number of enrollees considerably. Program features to increase continuous enrollment included annual (vs more frequent) reassessments of eligibility and options for enrollment in expanded coverage categories when individuals became ineligible for coverage under traditional Medicaid rules. The program was designed and implemented rapidly, with 6 months between waiver submission and program implementation. Thus, the first year of TennCare (1994) was marked by widespread confusion among health care providers and patients. To study the effects of TennCare on continuity of enrollment of children, the year after the transition (1995) was chosen. For comparison, continuity of enrollment was measured during a 1-year period before TennCare (1992).

STUDY GROUPS

Infants in the First Year of Life

We used linked birth and death certificates, linked with Medicaid and TennCare enrollment files, to identify all infants born to women who were Tennessee residents during 1992 (before TennCare) or 1995 (after TennCare). The study cohort included infants who had a plausible birth weight (400-5000 g), who were born to a mother enrolled on the day of delivery, and for whom no demographic or prenatal care data were missing on their birth certificate (99.2% of all infants). Follow-up began on the date of birth and ended on the first birthday. Infants who died during the first year of life were excluded (n = 823, 1.2% of the infants), as infants who died would have incomplete follow-up information.

Children Hospitalized With a Chronic Health Condition

Children hospitalized with a chronic health condition during 1992 (before TennCare) or 1995 (after TennCare) were identified from Medicaid or TennCare inpatient encounter files. This group included children aged 0 through 18 years who were enrolled in Medicaid any time during calendar year 1992 or calendar year 1995, had complete demographic information in the enrollment files (99.2% of the enrollees), and were discharged from a hospital during 1992 or 1995 with a discharge diagnosis consistent with a chronic health condition. Hospitalizations were used to identify the subset of children with the greatest degree of illness severity among children with chronic health conditions. Children hospitalized with greater illness severity are most likely to require continuous health insurance coverage in the year following hospital discharge. Hospitalizations for chronic health conditions were identified from International Classification of Diseases, Ninth Revision, Clinical Modification codes in any 1 of 5 discharge diagnosis fields. Qualifying diagnoses included asthma (code 493), congenital heart disease and diseases involving the heart (codes 745-747 and 390-459), diabetes mellitus (code 250 or 251), sickle cell disease (code 282.6), cerebral palsy (code 343), epilepsy (code 345), neoplastic disease (codes 140-208), renal disease (codes 580-583 and 585-588), bronchopulmonary dysplasia (code 770.7), and cystic fibrosis (code 277.0). Follow-up began on the date of hospital discharge (during 1992 or 1995) and ended 1 year after hospital discharge. If a child had multiple hospitalizations during either period, only the first was included. If a child had diagnoses fitting multiple categories, the primary diagnosis from the first hospitalization during the period was included. We excluded hospitalized children who died within 1 year of discharge (n = 98, 1.4% of the children), as children who died would have incomplete follow-up information.

OUTCOMES

Infants in the First Year of Life

Study outcomes, identified from the enrollment files, were failure to enroll an infant in the first 30 days of life and, for infants enrolled in the first 30 days of life, subsequent gaps in enrollment of 7 days or longer during the first year of life. A combined outcome of either not being enrolled by 30 days of life or having a subsequent gap in coverage was created to evaluate the overall proportion of infants without continuous coverage from birth through the first birthday.

Children Hospitalized With a Chronic Health Condition

Study outcomes, identified from the enrollment files, were any gap in enrollment lasting 7 days or longer by 3, 6, 9, and 12 months following hospital discharge.

ANALYSIS

Comparisons between infant and maternal characteristics before and after the implementation of TennCare were made using χ² analysis. Unconditional multivariate logistic regression was used to compare outcome proportions for 1995 with those for 1992 (the reference category). Regression models for infant enrollment included maternal and infant characteristics from the birth certificate that could plausibly affect enrollment continuity (before or after TennCare): maternal age, race, and educational level; residence in an urban or rural county; region of the state; the mean income of the mother’s neighborhood at delivery (from 1990 US Census Bureau data); number of cigarettes smoked per day by the mother; marital status; having a primiparous mother; mother’s late entry into prenatal care; having an inadequate number of prenatal care visits; infant birth weight; and birth year. To determine if enrollment outcomes changed for infants at highest risk for poor access to care, analyses for infant enrollment were performed that were stratified by maternal educational level and race. For children hospitalized with a chronic health condition, logistic regression models controlled for a child’s characteristics from the enrollment files thought to influence continuous enrollment, including the child’s age, race, sex, residence in an urban or rural county, region of the state, and year of hospital discharge before or after TennCare. All analyses were performed with a computer program (SAS, version 6.12; SAS Institute Inc, Cary, NC) running under an operating system (Windows NT 4.0; Microsoft Corp, Redmond, Wash) on a personal computer (Pentium P6; Intel Corp, Santa Clara, Calif).
INFANTS IN THE FIRST YEAR OF LIFE

Following the implementation of TennCare, there was a decrease in the proportion of births in which the mother was enrolled in Medicaid at delivery (Table 1). In addition, there were differences in the proportions of infants with certain sociodemographic characteristics. Differences after vs before enrollment in TennCare were most pronounced for the proportions of mothers with less than 12 years of education, mothers who resided in a neighborhood with the lowest income quintile, and mothers who smoked (P < .001 for all differences) (Table 1).

The proportion of infants not enrolled in the first 30 days of life increased after the implementation of TennCare (Table 2). When controlling for sociodemographic differences in the populations before and after TennCare using multivariate analysis, these differences were statistically significant. On the other hand, infants born after the implementation of TennCare who were enrolled within the first 30 days of life were less than half as likely to have subsequent gaps in enrollment during the first year of life. Overall, the combined effect of more infants failing to be enrolled by 30 days of life and less enrolled infants having gaps in enrollment resulted in a reduction in the proportion of infants without continuous enrollment in the first year of life following the implementation of TennCare. Stratified analyses for continuity outcomes by maternal educational level and maternal race were not materially different from the primary analysis.

CHILDREN HOSPITALIZED WITH
A CHRONIC HEALTH CONDITION

During 1992, there were 3475 children aged 0 to 18 years enrolled in Medicaid who had at least 1 hospitalization with a diagnosis consistent with a chronic health condition, representing 0.8% of the 439 363 children aged 0 to 18 years enrolled in Medicaid during 1992. The proportion of children hospitalized with a chronic condition was slightly lower during 1995, when 3259 of the 578 757 children aged 0 to 18 years enrolled in TennCare had at least 1 hospitalization with a diagnosis consistent with a chronic health condition (0.6% of the total enrollees). Asthma accounted for most enrollees with a chronic health condition (59.9% of the combined enrollees from both years of the study), followed by congenital heart disease and diseases involving the heart (15.0%), diabetes mellitus (5.8%), and sickle cell disease (5.2%) (Table 3). There was an increase in children hospitalized with a diagnosis of bronchopulmonary dysplasia during 1995 vs 1992.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of Tennessee births</td>
<td>72,617</td>
<td>72,278</td>
</tr>
<tr>
<td>Total infants enrolled in Medicaid or TennCare at birth, No. (%)</td>
<td>35,708 (49.2)</td>
<td>34,365 (47.5)</td>
</tr>
</tbody>
</table>

Table 1. Population Characteristics for Infants Born in Tennessee to Mothers Enrolled in Medicaid During 1992 or 1995*

Table 2. Enrollment Continuity During the First Year of Life for Infants Born in Tennessee to Mothers Enrolled in Medicaid During 1992 or 1995*

*Data are given as percentage of each subgroup, unless otherwise indicated. Infants are defined in this study as persons aged 0 to 12 months. TennCare is Tennessee’s Medicaid managed care program.
†Identified from Tennessee birth certificates.
‡P < .01 (before vs after TennCare using χ² analysis).
§P < .001 (before vs after TennCare using χ² analysis).
¶Calculated from 1990 US Bureau of the Census data using the mother’s address at the time of delivery.

*Data are given as number (percentage) of each subgroup, unless otherwise indicated. Infants are defined in this study as persons aged 0 to 12 months. Ellipses indicate data not applicable. TennCare is Tennessee’s Medicaid managed care program.
†The odds ratios were adjusted with logistic regression models for maternal age, race, and educational level; residence in an urban or rural county; region of the state; block group income; number of cigarettes smoked per day by the mother; marital status; having a primiparous mother; mother’s late entry into prenatal care; having an inadequate number of prenatal care visits; infant birth weight; and year of birth. The reference category is before TennCare.
‡P < .001.
§Proportion based on infants enrolled within the first 30 days of life.
Following the implementation of TennCare, there was a decrease in the likelihood that children discharged from the hospital with a chronic health condition would have subsequent gaps in enrollment (Table 4).

This study of continuity of enrollment for high-risk infants and children before and after the implementation of TennCare demonstrates that one of the stated goals of the TennCare program was met.9,10 For infants in the first year of life and children hospitalized with a chronic health condition, fewer children had gaps in coverage after the implementation of TennCare compared with before the implementation of TennCare. Improvements in enrollment following the implementation of TennCare may have resulted from multiple factors, including (1) changes in program and policy at the state level, (2) changes in financial incentives for managed care organizations and physicians to keep patients enrolled, and (3) increased public and individual awareness of TennCare.

Several changes in program and policy under TennCare may have increased the likelihood that children would remain enrolled. First, according to TennCare standard operating procedure, reevaluation of an individual’s enrollment status occurred only once per year, regardless of any change in participation in the Aid to Families With Dependent Children program.15 In contrast, under Medicaid, more frequent reevaluation of a child’s eligibility for the Aid to Families With Dependent Children program resulted in more opportunities for loss of enrollment. Second, TennCare included children in working families otherwise lacking insurance who would have previously been excluded from Medicaid. The presence of specific procedures for continuing TennCare enrollment for persons losing Aid to Families With Dependent Children benefits due to increases in income may have contributed to better continuity of enrollment.13 On an administrative level, the state contract for TennCare specifically mandated that managed care organizations operating under TennCare were to provide case management through primary care providers, which might aid enrollees in navigating the bureaucratic hurdles to obtaining health insurance, including the enrollment of eligible individuals.29 In addition to contractual obligations, managed care organizations had financial incentives to ensure that recipients remained enrolled in TennCare, since payment from the state depended on the number of plan enrollees, even though these incentives may have been offset somewhat by increased costs for children with chronic health conditions.15 Physicians had similar financial incentives to keep individuals enrolled in TennCare, as their participation in capitated plans linked their compensation to the number of enrollees choosing them as a primary care provider.15

Extensive media coverage of TennCare may have increased public awareness of managed care on a population level. Numerous articles15,30 detailed the transition to TennCare and subsequent program and policy changes, including expansions of coverage for children. Many of the advertising materials distributed by the managed care organizations included information about preventive care for children, including the importance of childhood immunizations. Information from multiple media sources might have increased enrollee’s knowledge of the importance of obtaining preventive care for their children, thereby affecting their enrollment.31-33

Another potential explanation for improvements in continuity of enrollment following the implementation of TennCare is that the populations receiving benefits changed following TennCare implementation and that these differences accounted for improvements in enrollment continuity. For example, mothers of infants born following the implementation of TennCare had slightly increased awareness of TennCare benefits due to increases in income may have contributed to better continuity of enrollment.13

### Table 3. Children Enrolled in Medicaid and Discharged From a Hospital With a Chronic Health Condition During 1992 or 1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>2118</td>
<td>1918</td>
<td></td>
</tr>
<tr>
<td>Congenital heart disease and diseases involving the heart</td>
<td>470</td>
<td>538</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>208</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>Sickle cell disease</td>
<td>183</td>
<td>167</td>
<td></td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>108</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>Epilepsy</td>
<td>215</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Neoplastic disease</td>
<td>86</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Renal disease</td>
<td>36</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Bronchopulmonary dysplasia</td>
<td>19</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Cystic fibrosis</td>
<td>32</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

*a Children are defined in this study as persons aged 0 to 18 years. TennCare is Tennessee’s Medicaid managed care program.

### Table 4. Enrollment Continuity in the 365 Days Following Hospital Discharge for Children Enrolled in Medicaid and Discharged From a Hospital With a Chronic Health Condition During 1992 or 1995

<table>
<thead>
<tr>
<th>Enrollment Pattern</th>
<th>Before TennCare (1992)</th>
<th>After TennCare (1995)</th>
<th>Odds Ratio (95% Confidence Interval)*†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaps in enrollment by 3 mo after discharge</td>
<td>7.6</td>
<td>3.0</td>
<td>0.36 (0.28-0.46)</td>
</tr>
<tr>
<td>Gaps in enrollment by 6 mo after discharge</td>
<td>13.4</td>
<td>6.2</td>
<td>0.41 (0.34-0.49)</td>
</tr>
<tr>
<td>Gaps in enrollment by 9 mo after discharge</td>
<td>18.6</td>
<td>9.3</td>
<td>0.42 (0.37-0.49)</td>
</tr>
<tr>
<td>Gaps in enrollment by 1 y after discharge</td>
<td>23.3</td>
<td>14.3</td>
<td>0.52 (0.46-0.59)</td>
</tr>
</tbody>
</table>

*Data are given as percentage of each subgroup, unless otherwise indicated. A gap in enrollment is defined as a lapse in enrollment of 7 days or longer. All comparisons were significantly different (P < .001). Children are defined in this study as persons aged 0 to 18 years. TennCare is Tennessee’s Medicaid managed care program.

†The odds ratios were adjusted with logistic regression models for child’s age, race, sex, residence in an urban county, region of the state, and year of hospital discharge (before or after TennCare). The reference category is before TennCare.
more years of education and higher median neighborhood incomes and were less likely to be smokers. Similarly, changes in criteria for hospitalization might have resulted in the admission of children with more severe health conditions following the implementation of TennCare. However, our findings persisted after controlling for these and other variables thought to influence continuity of enrollment. For infants, analyses stratified by maternal educational level and maternal race were not substantially different from the primary analysis.

The overall improvements in enrollment for infants occurred despite a doubling of infants after the implementation of TennCare who were not enrolled in the first 30 days of life, even though their mother was enrolled at delivery. The procedure for notification of births and subsequent enrollment of infants did not change after the implementation of TennCare, making it unlikely that procedural issues played a role. It is possible that having multiple plans as potential sources of entry into the system created some barriers, as after the implementation of TennCare there were 12 different managed care organizations providing care to TennCare enrollees vs a single state organization before the implementation of TennCare. This finding emphasizes that infants whose mothers are enrolled, but who failed to be enrolled themselves in the first 30 days of life, represent an important target for development of policies to ensure enrollment of all eligible individuals.

In the past, Medicaid programs have often been characterized by noncontinuous coverage of enrollees, and it has been shown that children with gaps in insurance coverage often lack a regular source of health care. Furthermore, children with gaps in insurance coverage are less likely to receive routine and preventive services. For the 2 groups we studied, the implementation of TennCare improved continuity of coverage. Despite improvements, nearly 20% of infants and 14% of children with chronic health conditions did not have continuous coverage following the implementation of TennCare. Further study is warranted to compare child health outcomes for infants and children with and without continuous enrollment to quantify the effects of loss of enrollment on these vulnerable populations.

Accepted for publication March 24, 1999.

Reprints: William O. Cooper, MD, MPH, Division of General Pediatrics, Vanderbilt University, Suite 3028 Medical Center East, Nashville, TN 37232-8555 (e-mail: william.cooper@mcmail.vanderbilt.edu).

REFERENCES

6. Epstein AM. Medicaid managed care and high quality: can we have both? JAMA. 1997;278:1617-1621.