Newborn Length of Stay, Health Care Utilization, and the Effect of Minnesota Legislation

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Objective: To describe newborn length of stay, post-discharge follow-up, and health care utilization in the context of Minnesota’s early discharge legislation.

Design and Setting: Retrospective study using claims data from a large managed care organization.

Participants: Term newborns born from January 1995 through February 1999 (N=22944).

Outcome Measures: Newborn length of stay, home or clinic visits within 1 week of discharge (early follow-up), immunizations completed by age 3 months, readmissions within 1 month of discharge, and urgent care or emergency department visits within 2 months of discharge.

Results: After enactment of Minnesota’s early discharge legislation in 1996, the percentage of newborns with short stays (0-1 days after vaginal birth or 2-3 days after cesarean birth) decreased from 52% to 16% for vaginally born infants and from 87% to 63% for cesarean-born infants (P=.001). Although the legislation mandated coverage for home visits after short stays, only 12.4% of short-stay newborns had early home visits. Overall, 50% of infants had early home or clinic follow-up; compared with those who did not receive early follow-up, these infants were more likely to have complete immunizations (adjusted odds ratio [OR], 1.09; 95% confidence interval [CI], 1.03-1.14), urgent care or emergency department visits (adjusted OR, 1.22; 95% CI, 1.07-1.39), and readmissions (adjusted OR, 2.49; 95% CI, 2.02-3.08).

Conclusions: Although implementation of Minnesota’s early discharge legislation corresponded with significantly increased lengths of stay, very few short-stay infants received the postdischarge care for which coverage was mandated. Our findings indicate, however, that infants at higher risk for adverse outcomes were appropriately identified to receive early follow-up.

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62% of short-stay newborns. An earlier study by 1 of us (D.J.M.-K.) found that only 30% of infants discharged early by family physicians in Minnesota and Wisconsin during 1997 received initial follow-up visits within 2 to 3 days of discharge.2

Whether newborns who do not receive the recommended postnatal services are at increased risk of morbidity is unclear. The purpose of this study was to answer the following questions for infants born in Minnesota using claims data from a large managed care organization: What have been the effects of the state’s early discharge legislation? What postnatal services actually are being received by newborns? And is newborn health service utilization affected by newborn length of stay and postdischarge follow-up?

METHODS

POPULATION

HealthPartners is a managed care organization that provides health care services and coverage to more than 650000 members in Minnesota, 30% of whom receive care in staff model clinics and 70% at contracted clinics. The study population was identified using HealthPartners claims data and consisted of infants born from January 1995 through February 1999, with the following exclusions: premature infants, multiple gestations, newborns discharged on different days than their mothers, infants not continuously enrolled for 3 months after discharge, and infants with lengths of stay (LOS) longer than 25 days. Three additional infants were excluded who, according to the claims data, had a cesarean birth and a LOS of 0 or 1 day. A total of 22944 infants met the inclusion criteria.

STUDY DEFINITIONS

We defined LOS as the date of discharge minus the date of delivery; for example, an infant discharged the day after delivery had a LOS of 1 day. Although the Minnesota and federal early discharge legislation referred to LOS by hours, time of birth and discharge were not available to the investigators. However, because LOS of 0 and 1 days are clearly less than 48 hours and LOS of 3 or fewer days are clearly less than 96 hours, these were considered to be short hospital stays, as defined by the legislation, for infants with vaginal and cesarean births, respectively.

Early follow-up was defined as any home or office-based services received by infants within 1 week of discharge. All home visits were counted as a home-based service for the infant, regardless of who was billed. Recommendations regarding the timing of the first newborn follow-up visit after early discharge have varied, from the AAP guideline of a visit within 2 days of discharge to the 4-day criterion in the Minnesota legislation.3 Because the early follow-up recommendations represent a major change from the traditional 2-week follow-up visit,4 we chose to define an early visit using the liberal criterion of within 1 week after discharge.

Immunizations were considered to be complete when an infant had received 1 diphtheria and tetanus toxoids and pertussis vaccine (DTP), 1 Haemophilus influenzae type b vaccine (Hib), 1 oral poliovirus vaccine (OPV), and 1 hepatitis B immunization by age 3 months.

Additional utilization variables included clinic visits and urgent care or emergency department visits within 2 months of discharge. Hospital readmissions within 1 month of initial discharge were also studied.

STATISTICAL ANALYSES

Receipt of Early Postnatal Services

Frequency and χ² statistics were used to compare LOS with receipt of early follow-up before and after enactment of the Minnesota LOS legislation. Similar tests were performed to analyze differences in receipt of early follow-up by LOS. Breslow-Day tests for homogeneity of odds ratios (ORs) were performed to test if differences in the likelihood of early follow-up varied significantly by LOS, before and after enactment of the law. Logistic regression analysis was used to calculate ORs for short stays, adjusting for differences in type of delivery (vaginal vs cesarean), maternal age (measured in years), and seasonality (with winter births defined as those occurring from October through April).

Outcomes

Using logistic regression, we examined differences in the proportions of newborns with complete immunizations at 3 months of age who had an urgent care or emergency department visit within 2 months of discharge and who were readmitted within 1 month of discharge. Predictor variables in these analyses included type of delivery (vaginal vs cesarean), LOS, receipt of early follow-up (any vs none), and maternal age (in years). Variables were kept in the regression models if they were statistically significant (α = .05). Analyses were performed using SAS statistical software, version 6.12 (SAS Institute Inc, Cary, NC). The study was approved by the HealthPartners Institutional Review Board.

RESULTS

SAMPLE CHARACTERISTICS

Of the 22944 infants who met the study criteria, 85% were born by vaginal delivery and 15% by cesarean delivery. Nearly one third (30%) were born before the enactment of Minnesota maternity LOS legislation in March 1996. Fewer than 2% had Medicaid or state health insurance for the poor, and 98.7% had HealthPartners insurance. Managed care for Medicaid recipients was uncommon at the time of the study. Maternal age ranged from 15 to 52 years (mean age, 30 years).

LENGTH OF STAY

Length of stay for all infants is shown in Table 1. Infants with vaginal and cesarean births were both more likely to have longer LOS after the enactment of the Minnesota LOS law (P = .001). Overall, 74% of infants with a vaginal birth had a LOS of at least 2 days. This percentage increased from 48.1% before to 84.5% after the enactment of the law. Among infants with a cesarean birth, 30% had a LOS of at least 4 days. This percentage increased from 12.7% to 37.4% after enactment of the law. LOS was strongly associated with when birth occurred relative to enactment of the law: Among infants with vaginal births, those born after the legislation were 6 times more likely to have longer stays (adjusted OR,
6.03; 95% confidence interval [CI], 5.62-6.48); among infants born by cesarean delivery, those born after the legislation were more than 4 times more likely to stay more than 3 days (adjusted OR, 4.27; 95% CI, 3.48-5.25).

**EARLY FOLLOW-UP**

Overall, 50% of infants in the study sample had early home or clinic follow-up visits. Infants born vaginally with LOS of 0 or 1 days were no more likely to have early follow-up than were those with longer stays (51% vs 49%; P = .07) (Table 2). Infants born by cesarean delivery who had LOS of 2 or 3 days were less likely to have early follow-up than were infants with LOS of 4 or more days (46% vs 53%; P = .001). Comparing the periods before and after enactment of the Minnesota LOS law, infants born vaginally with short stays, for whom early follow-up visits were recommended and coverage was mandated, were less likely to have visits after the law was enacted, whereas infants with longer LOS were more likely to have early follow-up after the law. We observed no effect of the law on the receipt of early follow-up visits for infants with cesarean births.

Looking at home visits separately, overall, 2308 infants (10%) received home visits within 1 week of discharge; all home visits were provided by nurses. The Minnesota legislation requires that insurers cover a visit from a home health nurse within 4 days of discharge for infants who are discharged before 48 hours after vaginal births and 96 hours after cesarean births. After the law was enacted, 12.4% of infants discharged early received a visit from a home health nurse, and 97% of the visits did occur within 4 days of discharge. The percentage of home visits increased significantly after the legislation for infants in each LOS and delivery group. For example, among vaginally born infants with longer stays, for whom coverage of early home visits was mandated, we observed an increase in early home visits after the legislation from 2% before the law to 12% after (P = .001); this increase was significantly greater (P = .001) than that observed among vaginally born infants with short stays.

**OUTCOMES**

The timing of the infants’ clinic visits from days 8 to 60 (excluding early clinic visits in the first week after discharge) clustered around the traditional 2-week and 2-month well-baby visits. This pattern was the same whether or not the infant had early follow-up. Overall, 5% of infants had no clinic visits within 2 months of discharge, 19% of infants had 1 clinic visit, and 26% had 2 clinic visits within 2 months of discharge. Table 3 presents the factors that were significantly associated with receiving complete immunizations by age 3 months. Taking maternal age and LOS into account, the odds of receiving all immunizations by age 3 months were almost 10% higher for infants with early follow-up (adjusted OR, 1.09; 95% CI, 1.03-1.14).

Overall, 4% of infants had an urgent care or emergency department visit within 2 months of discharge. Infants who received early follow-up were more likely to have urgent care or emergency department visits than were infants without early follow-up (4.6% vs 3.8%; P = .002), although the percentage of infants with urgent care or emergency department visits did not differ significantly by infants’ LOS. The odds of having an urgent care or emergency department visit were about 22% higher for infants who had early follow-up (adjusted OR, 1.22; 95% CI, 1.07-1.39), taking into account maternal age and initial length of stay (Table 3).

Overall, 1.9% of infants were readmitted within 1 month of initial discharge. Infants with shorter LOS were more likely to be readmitted. Comparing infants with and without early follow-up, the rates of readmission were 2.7% and 1.0%, respectively (P = .001). Among the readmitted infants, 64% of those who had early follow-up were readmitted in the first week after initial discharge, compared with 14% of those without early follow-up. Controlling for other factors, the odds of readmission were about 2.5 times higher for infants with early follow-up (adjusted OR, 2.49; 95% CI, 2.02-3.08).

**COMMENT**

During the period following enactment of the Minnesota maternity LOS law, the LOS for newborns increased. Other states have had similar increases in LOS following enactment of LOS legislation.6,7 Although we found that LOS was influenced by factors such as maternal age and month of delivery, the enactment of the law had by far the largest effect. Infants born after the law were from 4 to 6 times more likely to have stays beyond the early discharge cutoff points.

Traditionally, pediatricians have scheduled an initial well-baby visit for most newborns at age 2 weeks.5 However, reflecting the general consensus that the clinical importance of early postdischarge follow-up increases as hospital stays become shorter, using the 2-week checkup as the first well-baby assessment is generally considered to be inadequate for infants discharged early.6 Overall, 50% of infants in this study had at least 1 home or clinic follow-up visit within the first week after discharge, suggesting that clinical practice

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**Table 1. Length of Stay (LOS) of Study Infants by Type of Delivery and Time Period Relative to Early-Discharge Legislation**

<table>
<thead>
<tr>
<th></th>
<th>Vaginal Delivery</th>
<th>Cesarean Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOS, d†</strong></td>
<td>Before Law (N = 5635)</td>
<td>After Law (N = 13882)</td>
</tr>
<tr>
<td>0</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>1</td>
<td>51.4</td>
<td>15.3</td>
</tr>
<tr>
<td>2</td>
<td>46.0</td>
<td>80.6</td>
</tr>
<tr>
<td>3</td>
<td>1.7</td>
<td>3.3</td>
</tr>
<tr>
<td>4</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>5-25</td>
<td>0.2</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*NThe sample excluded premature infants, multiple gestations, and newborns discharged on different days than their mothers (N = 22,944 term newborns born January 1995 through February 1999). Minnesota legislation was enacted in March 1996. Data are presented as the percentage of infants.
†Calculated as the date of discharge minus the date of delivery.
patterns are indeed changing. However, infants in this study with shorter stays were no more likely to receive early follow-up than were infants with longer stays. Most of the follow-up visits took place in the clinic setting rather than at home.

Although federal LOS legislation does not include any postdischarge care requirements for infants discharged early, most state LOS legislation does.8 Nurse home visits, the follow-up service for which coverage was mandated by Minnesota law, were received by only 12.4% of newborns discharged early in this study. Although enactment of the law was associated with an increase in home health nurse visits for all infants, infants with longer stays and hence no mandated coverage for home visits were just as likely to receive such visits as were short-stay infants with mandated coverage. The discrepancy (regarding the location and timing of follow-up visits) between the Minnesota legislation and other recommendations, such as that endorsed by the AAP, may have contributed to the relatively infrequent use of home visits we observed.3

Many research studies have focused on the associations between the numbers of hours of LOS and selected newborn outcomes, such as urgent care or emergency department visits or readmissions, without specifically examining the receipt of postdischarge follow-up. These studies have had conflicting results.9-17 Several studies have evaluated the effect of early follow-up visits on newborn health service utilization.10,11,13,18-21 Most of these studies evaluated specific early discharge programs that included visits from home health nurses and found that the numbers of urgent care or emergency department visits and readmissions were unchanged or decreased for infants in these programs compared with infants with longer LOS.10,11,18,19,21

In contrast, this study found that infants with early follow-up visits were significantly more likely to have subsequent urgent care or emergency department visits and readmissions. This finding may reflect the fact that, rather than being provided within the context of a specific early discharge program, follow-up visits for these newborns were ordered at the discretion of the clinicians. The low prevalence of early follow-up visits for short-stay infants suggests that early discharge in and of itself was not considered a risk factor by most clinicians and that early follow-up was not being used to routinely monitor healthy-appearing infants after early discharge. Instead, early follow-up appears to have been provided to those infants who, regardless of their LOS, were considered to be at potentially increased risk of problems. Our findings suggest that clinicians did successfully identify and provide early follow-up visits for infants at higher risk for urgent care or emergency department visits and readmissions. Unfortunately, the factors used by clinicians to identify these higher risk infants cannot be determined from the claims data we examined.

Our study does have several limitations. First is that our study methods cannot determine whether the changes we noted in LOS and follow-up were actually caused by the legislation. Claims data also have some limitations as a source of data. The generalizability of the results may also be limited, certainly to mothers with insurance only. Births to Medicaid recipients were also underrepresented in our population.

In summary, the Minnesota LOS legislation enacted in 1996 was associated with a significant increase in newborn hospital stays after birth. However, we found no increase in early follow-up visits among newborns with short stays; only a minority of infants discharged early received the postdischarge care for which coverage was

### Table 2. Percentage of Infants Receiving an Early Follow-up Visit by Length of Stay (LOS), Type of Delivery, and Time Period Relative to the Minnesota LOS Legislation*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Vaginal Delivery</th>
<th>Cesarean Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entire Study Period</td>
<td>Before Law</td>
</tr>
<tr>
<td>Short stay†</td>
<td>51</td>
<td>54</td>
</tr>
<tr>
<td>Longer stay</td>
<td>49</td>
<td>45</td>
</tr>
</tbody>
</table>

*An early follow-up visit was defined as a home or clinic visit within 1 week of discharge. Minnesota legislation was enacted in March 1996.
†Short stay was defined as 0 to 1 days after vaginal delivery and 2 to 3 days after cesarean delivery.
‡P = .001, compared with the proportion observed before legislation.
§P = .001, compared with the proportion of cesarean-born infants with short stays.

### Table 3. Associations of Postnatal Length of Stay (LOS) and Early Follow-up With Selected Newborn Outcomes*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Complete Immunizations by Age 3 Months</th>
<th>≥1 Urgent Care or Emergency Department Visits Within 2 Months of Discharge</th>
<th>≥1 Readmissions Within 1 Month of Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS, d</td>
<td>11.1 (1.08-1.15)</td>
<td>1.04 (0.99-1.10)</td>
<td>0.85 (0.75-0.97)</td>
</tr>
<tr>
<td>Early follow-up, any vs none†</td>
<td>1.09 (1.03-1.14)</td>
<td>1.22 (1.07-1.39)</td>
<td>2.49 (2.02-3.08)</td>
</tr>
</tbody>
</table>

*Models included LOS, early follow-up, and maternal age (not shown).
†Early follow-up was defined as a home or clinic visit within 1 week of discharge. No early follow-up is the reference group.
Although AAP guidelines recommend that all newborns discharged less than 48 hours after delivery be examined within 2 days of discharge, federal legislation includes no requirements regarding postdischarge care, and state requirements vary considerably. Minnesota early discharge legislation enacted in March 1996 requires coverage of 1 or more home visits by a registered nurse for a mother and infant who voluntarily leave early. The purpose of this study is to describe the changes in newborn LOS, postdischarge follow-up, and health care utilization associated with enactment of the Minnesota legislation.

Implementation of Minnesota’s early discharge legislation corresponded with significantly increased LOS. However, very few short-stay infants received the postdischarge care for which coverage was mandated. Infants with early home or clinic follow-up were more likely to have urgent care or emergency department visits and readmissions, suggesting that infants at higher risk for adverse outcomes were appropriately identified to receive early follow-up.

mandated. Because infants with any LOS who did receive early visits were more likely to have urgent care or emergency department visits and readmissions, it appears that clinicians successfully identified and provided early follow-up care to infants at higher risk for adverse outcomes. Future research should focus on identifying those risk factors and on developing practical risk assessment instruments, as recommended in the Advisory Committee’s report to Congress.1

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