Moderately preterm infants and determinants of length of hospital stay

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ABSTRACT

Background: Moderately preterm infants account for a large proportion of admissions and bed-days in neonatal units (NU). Management of these infants varies and determinants of length of stay are poorly studied.

Objective: To determine postmenstrual age at hospital discharge for moderately preterm infants and its relation to perinatal risk factors and to organisation of care.

Methods: Population-based cohort including 2388 infants, born in 2004–2005 with a gestational age (GA) of 30–34 weeks and admitted to 21 NU reporting to the Swedish perinatal register. Main outcome: postmenstrual age (PMA) at hospital discharge to home.

Results: Mean PMA at hospital discharge was 36.9 (1.7) weeks. High (≥35 years) maternal age, multiple birth, small for gestational age, respiratory distress syndrome, infection, hypoglycaemia and hyperbilirubinaemia were significantly associated with higher PMA at discharge, but could only explain 13% of the variation in PMA at discharge. Mean PMA at discharge differed by up to 2 weeks between hospitals. Infants treated at NUs without fixed discharge criteria had 4.7 days lower PMA at discharge and infants receiving domiciliary care had 9.8 days lower PMA at discharge. Breastfed infants also had lower PMA at discharge (mean 2.7 days lower) than those not breast fed, partly explained by lower morbidity in the breastfed infants.

Conclusions: Perinatal risk factors have small overall impact on length of hospital stay in moderately preterm infants. Organisation of care is probably an important factor. The number of bed-days differs significantly between centres, which may have effects on quality of care and health economy.

What this study adds

- Maternal and neonatal risk factors have small impact on length of hospital stay in moderately preterm infants. Availability to co-care for mother and infant and access to domiciliary care may be of greater importance.
- The number of bed-days differs significantly between centres, which may have effects on quality of care and health economy.
- Shorter hospitalisation is an alternative, provided that a combination of adequate home support, successful breast feeding and medical safety can be maintained.

Moderately preterm infants born between 30 and 34 gestational weeks occupy almost half of available beds in neonatal units (NU).[1 2] Despite this large proportion of total neonatal utility, determinants of length of hospital stay (LOS) are poorly defined.

Significant variations between NUs regarding LOS for moderately preterm infants have been reported in studies from the United States[3–5] and Finland.[6] Differences in social epidemiology, birth complications and infant morbidity did not explain these variations. The conclusions from these studies were that local traditions and care practice seemed to have more influence on LOS than evidence-based knowledge and general safety guidelines.

In order to improve quality of care for moderately preterm infants and their families, and to save resources and open up hospital beds, different interventions have been suggested and implemented.[7–9] Domiciliary care programmes have been introduced in uncomplicated cases.[10] However, this and other strategies for a safe and cost-effective outcome have not been evaluated on a population-based level. The aim of this study is to determine postmenstrual age (PMA) at discharge for preterm infants born between 30 and 34 completed gestational weeks in Sweden and to relate the findings to perinatal risk factors and organisation of care.

METHODS

Study design and population

This observational study was based on data from the Swedish PeriNatal Quality (PNQ) register (PNQ, MedSciNet AB, Sweden). During the years 2004–2005, 21 out of 34 neonatal units in Sweden reported all their inpatients to the register. We extracted information on all infants admitted to these NUs with a gestational age (GA) at delivery from 30 to 34 completed weeks. Infants with one or more of the following diagnoses were excluded: major malformation, (renal n = 15, cardiac n = 126, central nervous system n = 5, gastrointestinal n = 39, cleft palate n = 13, miscellaneous n = 42), chromosomal anomalies (n = 21), major surgery (n = 35) or death (n = 36) during NU hospitalisation. We also excluded infants with missing information on LOS (n = 20). After exclusion, 2388 infants were included in the study (table 1).

Risk factors and outcomes

Maternal age, multiple birth, gestational length, birth weight and sex were considered as potential risk factors and were extracted from the PNQ register. Small for gestational age (SGA) was defined as a birth weight less than 2 standard deviations (SD) below the mean weight for gestational age according to reference data for normal fetal growth in the Swedish population.[11] Neonatal morbidity was characterised as: respira-

Table 1 Characteristics of preterm infants born between 30 and 34 completed gestational weeks (n = 2388)

Maternal data	
Age, years	31.2 (5.4)
Pregnancy data	
Antenatal steroid therapy	876 (37%)
Multiplets	612 (26%)
Gestational age (weeks)	32.8 (1.3)
Infant data	
Birth weight (g)	2086 (476)
Small for gestational age	301 (13%)
Male sex	1253 (52%)
Neonatal morbidity and treatment	
Apgar score 5 minutes <4	15 (0.6%)
Respiratory distress syndrome	291 (12%)
Mechanical ventilation	79 (3.3%)
Infection	320 (13%)
Antibiotic treatment	677 (28%)
Hypoglycaemia	430 (18%)
Hyperbilirubinaemia (requiring treatment)	1408 (59%)
Patent ductus arteriosus (requiring treatment)	30 (1.3%)
Bronchopulmonary dysplasia (oxygen therapy at 36 weeks of postmenstrual age)	22 (0.9%)
Severe neonatal morbidity*	34 (1.4%)

Values are mean (SD) or numbers (proportions).
*Severe neonatal morbidity include infants with one or more of the following diagnoses: retinopathy of prematurity grade 3–4, intraventricular haemorrhage grade 3–4 or bronchopulmonary dysplasia.

tory distress syndrome (RDS), infection, hypoglycaemia, hyperbilirubinaemia or severe neonatal morbidity, defined as any or several of the following diagnoses: intraventricular haemorrhage (IVH) grade 3–4, retinopathy of prematurity (ROP) ⩾ grade 3 or bronchopulmonary dysplasia (BPD), defined as oxygen supplementation at 36 weeks of gestation.

All 21 NUs reporting to the PNQ also responded to a questionnaire concerning availability to co-care of mother and infant, use of Neonatal Individual Developmental Care and Assessment Program (NIDCAP), and presence of fixed criteria for discharge home. Availability to organised domiciliary care was also reported. Domiciliary care denoted that requirements for oxygen and drug treatments, gavage feeding, phototherapy and monitoring of vital functions could be satisfied at home after structured parental education before discharge. The family would also have regular home visits from a nurse and/or a doctor, and an option to contact the hospital at all hours. The individual NUs' identities were blinded to the investigator during data collection and analysis. The participating NUs were categorised according to unit level I–III,[12] and unit size characterised by numbers of yearly admissions of infants with a GA of 30–34 completed weeks (less than 50 or at least 50), facilities for co-care of mother and infant, use of NIDCAP, fixed criteria for home discharge and/or domiciliary care programme.

Postmenstrual age (PMA) at discharge was considered the main outcome measure and was defined as number of days from last menstrual period, corrected for by first trimester ultrasound in all women. To specify the PMA at discharge data, the destination at hospital discharge (other clinic/hospital, domiciliary care or home without support) was investigated. Because bottle-fed preterm infants have been reported to have shorter hospital stay,[13] outcome data were stratified and analysed according to breast feeding or not. The study was approved by the local ethics committee at the Karolinska Institute.

Statistical analysis

Data are presented as mean (SD or 95% confidence intervals) or proportions (numbers and percentages). Differences in group means were tested by the Student t test and differences in proportions were tested with the χ^2 test. Linear regression analyses were used to evaluate contributions to PMA at discharge from the following risk factors: maternal age, GA at birth, multiple birth, sex, SGA, RDS, infection, hyperbilirubinaemia, hypoglycaemia, severe neonatal morbidity, hospital level and size (less than or at least 50 admissions per year, facilities for co-care of mother-infant, use of NIDCAP, fixed criteria for discharge and domiciliary care programme. Simple regression was performed. Variables with p values<0.20 were subsequently entered into stepwise forward multiple regression models. In the multivariate model, we included maternal age, multiple pregnancy, GA, SGA, sex and neonatal morbidity and studied contributions from these risk factors to PMA at discharge. Subsequently, data regarding hospital characterisation were added to the multiple regression model. A p value <0.05 was considered significant. The coefficients of determination (R^2) for the models were calculated.

The purpose of this study was to study risk factors for PMA at hospital discharge to home. Infants discharged to other clinics (n = 125) were therefore excluded from the risk factor analyses. Infants with a LOS of 3 interquartile distances above the 75th percentile (n = 10) were considered outliers and were also excluded from these analyses. The final number of infants for statistical analyses was 2253.

The 21 hospitals were categorised into three equally sized groups according to mean PMA at discharge: low (hospitals with PMA at discharge <36.6 weeks, n = 7), medium (36.6–37.0 weeks, n = 7) and high (>37.0 weeks, n = 7) PMA at discharge (fig 1). Hospitals with low PMA at discharge were compared with hospitals with medium and high PMA at discharge. All analyses were performed with Stata 9.2 software.

RESULTS

Characteristics of study population

Maternal age ranged from 16 years to 52 years with a mean value of 31 years. In all, there were 1776 singletons, 584 twins, 24 triplets and 4 quadruplets. The mean (SD) birth weight was 2086 (476) g, with a range of 706–4320 g (table 1). Mean (SD) weight at

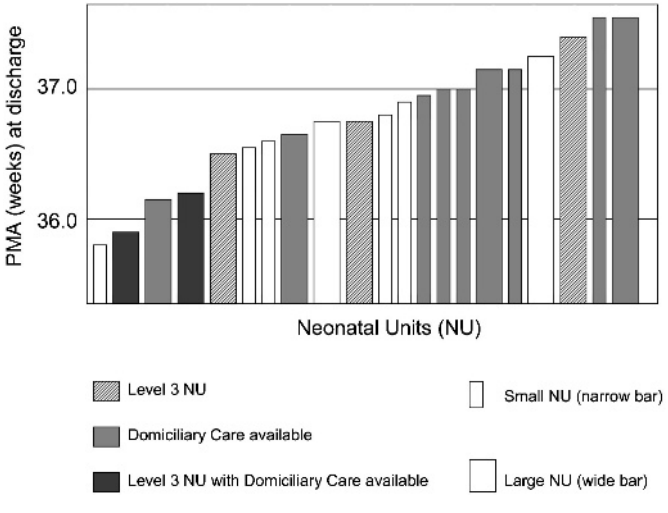

Figure 1 Postmenstrual age (PMA) at discharge over neonatal unit in moderately preterm infants (n = 2253).

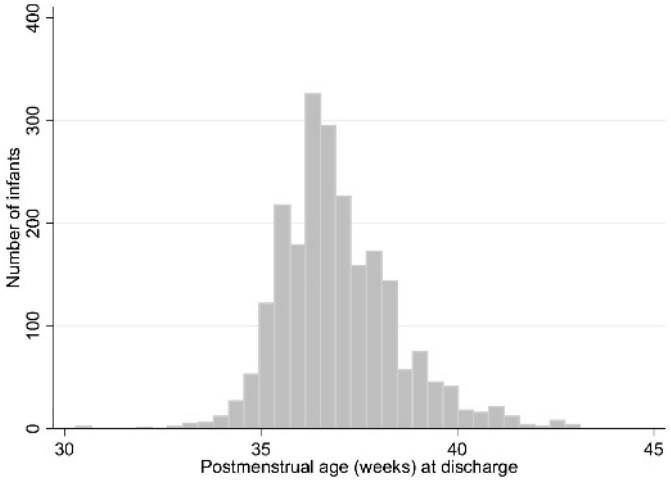

Figure 2 Distribution of postmenstrual age at discharge for moderately preterm infants (n = 2253).

hospital discharge to home was 2561 (439) g, with a range of 1446–7465 g.

Maternal and neonatal risk factors and PMA at discharge

The mean (SD) value of PMA at hospital discharge was 36.9 (1.7) weeks. PMA at discharge was normally distributed with a median value of 36.7 (range 30.3–46.7) weeks (fig 2). Female and male infants had the same mean value of PMA at discharge (36.9 weeks).

In both univariate and multivariate analyses, a higher PMA at discharge was associated with high (≥35 years) maternal age, multiple gestation, SGA and neonatal morbidity (table 2). There were no other maternal age strata (in 5-year intervals) that were significantly associated with PMA at discharge in multivariate analysis.

Low GA at birth was associated with increased PMA at discharge in univariate analysis but not after controlling for neonatal morbidity. Thus, the effect of GA on PMA at discharge could be explained by higher neonatal morbidity in more immature infants. Besides this effect, there were no significant differences among risk factors in univariate and multivariate analyses (table 2). Maternal and neonatal risk factors could only explain 13% ($R^2 = 0.13$, $p<0.001$) of the total variation in PMA at discharge.

Organisation of care and PMA at discharge

Co-care for mothers and infants born between 30–34 gestational weeks could be offered by 13 of the 21 NUs and NIDCAP was used as a strategy of care in nine NUs. Defined and general discharge criteria were used by 10 of the NUs, and three NUs reported that one of these criteria was a fixed GA. Although 11 NUs were not connected to an organised domiciliary care programme, discharge home with gavage feeding, apnoea monitoring or oxygen therapy could be offered in all units, and 18 of the units could offer all three treatments.

The mean PMA at discharge differed by up to 2 weeks between hospitals (fig 1). We found an over-representation of multiplets (27 vs 22%, p = 0.03) and hypoglycaemia (19 vs 15%, p = 0.02) in hospitals with medium to high PMA at discharge compared to hospitals with low PMA at discharge. There were no other statistically significant differences in perinatal risk factors between low and medium-high PMA hospitals.

Comparing hospitals with low PMA to hospitals with medium-high PMA at discharge, level 3 neonatal units, larger hospitals and hospitals without fixed criteria for discharge were over-represented in the lower tertile for PMA at discharge (table 3). These differences were not statistically significant, possibly because of limitations in statistical power. Practice of co-care of mother and infant, NIDCAP in use and available domiciliary care did not differ between hospitals with low compared to medium-high PMA at discharge.

Table 2 Maternal, neonatal and some hospital characteristics in moderately preterm infants and their significance for postmenstrual age (PMA, in days) at hospital discharge to home (n = 2253)

	Univariate analyses	Multivariate analysis
	β = regression coefficient (p value)	β = regression coefficient (p value)
Maternal and pregnancy data		
Maternal age ≥35* years	3.08 (<0.001)	2.39 (<0.001)
Maternal age 25–29 years	−1.74 (<0.001)	−0.75 (NS)
Multiple birth	4.54 (<0.001)	4.16 (<0.001)
Gestational age at birth	−0.74 (<0.001)	−0.26 (NS)
Small for gestational age	6.28 (<0.001)	5.42 (<0.001)
Neonatal morbidity		
Respiratory distress syndrome	4.88 (<0.001)	3.67 (<0.001)
Infection	3.69 (<0.001)	2.27 (0.001)
Hypoglycaemia	2.00 (0.001)	1.87 (0.001)
Hyperbilirubinaemia	1.52 (<0.001)	1.07 (0.010)
Severe neonatal morbidity†	12.7 (<0.001)	9.70 (<0.001)
Hospital characteristics		
Level 3 neonatal unit	−2.26 (<0.001)	−1.47 (0.001)
Fixed discharge age criteria	4.66 (<0.001)	3.27 (<0.001)
Small unit	0.43 (NS)	–
Domiciliary care	−9.76 (<0.001)	−9.62 (<0.001)
Intercept (days)		263.8 (<0.001)

R^2 in total multivariate model = 0.21 and without hospital characteristics = 0.13. A p value >0.05 was considered non-significant (NS).
*Some missing data on maternal age (n = 18/2253). In all lower maternal age strata, there were no significant associations between maternal age and PMA at discharge in multivariate analyses.
†Severe neonatal morbidity includes infants with one or more of the following diagnoses: retinopathy of prematurity grade 3–4, intraventricular haemorrhage grade 3–4 or bronchopulmonary dysplasia.

Table 3 Organisation of care for moderately preterm infants in hospitals with low (n = 7) compared to medium-high (n = 14) postmenstrual age (PMA) at discharge to home

	Low PMA at discharge*	Medium-high PMA at discharge†	p Value
Level 3 hospital	3/7 (43%)	2/14 (14%)	NS
Unit size ⩾50 infants/year	4/7 (57%)	6/14 (43%)	NS
Co-care mother-infant¶	5/7 (71%)	8/14 (57%)	NS
NIDCAP in general use¶	3/6‡ (50%)	6/14 (43%)	NS
Fixed criteria for discharge	0/7	3/14 (21%)	NS
Domiciliary care available¶	3/7 (43%)	8/14 (57%)	NS
Mean birth weight (g)	2087 (480)	2090 (466)	NS
Mean weight at discharge (g)	2450 (395)	2619 (447)	<0.001

Values are numbers of hospitals (proportions) or mean values (SD). p Values were calculated by χ^2 test (proportions) or t test (mean values) and considered non-significant (NS) if >0.05.
*Low PMA at discharge consisted of 7 hospitals with a low mean value of PMA at discharge (No of infants = 781), ranging from 35.7 to 36.6 postmenstrual weeks.
†Medium-high PMA at discharge consisted of 14 hospitals with a medium or high mean value of PMA at discharge (No of infants = 1472), ranging from 36.7 to 37.6 postmenstrual days.
‡One hospital in the study group did not report on NIDCAP use.
¶Although item could be provided, the number of infants actually receiving each item could be lower.

However, comparing characteristics of organisation of care on a hospital level may have introduced misclassification bias. Whereas there was no individual information on co-care of mother-infant or use of NIDCAP, infants admitted to domiciliary care could be identified in the PNQ register. An option for domiciliary care was reported by 11 of 21 hospitals, but only 110 infants were actually discharged to domiciliary care. The PMA at discharge for these infants was on average 9.8 days lower compared to infants discharged home without organised support (p<0.001). By adding NU characteristics available on an individual level into the multivariate regression model with maternal and neonatal risk factors, the R^2–factor for PMA at discharge increased from 13% to 21% (table 2).

Breast feeding and PMA at discharge

Exclusive breast feeding at discharge was seen in 56% of the infants and additionally 22% were partly breast fed (total n = 2054, missing data for 199 infants). Infants that were breast fed (exclusively or in part) had on average 2.7 days lower PMA at hospital discharge compared to infants that were not breast fed (p<0.001). Controlling for maternal risk factors and neonatal morbidity in multivariate analysis, the difference in PMA at discharge between breastfed infants and not breastfed infants decreased by 0.8 days.

Stratifying infants according to breast feeding, the associations between high maternal age and neonatal morbidities, and PMA at discharge were lost in the group of infants that did not breast feed at discharge (table 4).

DISCUSSION

The major finding in this population-based study of length of hospital stay in moderately preterm infants is that PMA at discharge varies considerably between hospitals. Perinatal risk factors and neonatal morbidity can only explain 13% of the variation in PMA at discharge between infants. Organisation of care seems to be equally or even more important than perinatal risk factors for the length of hospital stay (LOS).

Costs for neonatal care are closely related to LOS.[14–17] In Sweden, 20/1000 liveborn infants are moderately preterm; however, they account for almost 50% of total bed-days in the NU.[2] Shortening LOS for moderately preterm infants by 9 days—the effect associated with domiciliary care in previous studies[2 10]—would reduce the total need for neonatal beds by 15%. This permits reallocation of NU resources to the growing number of infants surviving extremely preterm birth.

Morbidity in moderately preterm infants is higher than in term infants.[17–23] Even though it is clear that morbidity is not the main determinant of LOS, we cannot exclude that neonatal morbidity below 32 weeks of GA may be more important for LOS than currently reported. A more detailed analysis of morbidity data in each GA stratum and their relation to LOS is a topic for further research.

Breast feeding has important short-term and long--term health implications for preterm infants.[24 25] Establishment of successful breast feeding in preterm infants should therefore be given high priority in neonatal care.[26] In contrast to previous reports,[13 27 28] we found that breastfed infants had a lower PMA at discharge compared to those not breast fed. After controlling for neonatal morbidity, the difference between the two groups decreased. This suggests that the lower PMA at discharge found in breastfed infants could be partly explained by healthier and more mature infants in the breastfed group compared to those

Table 4 Maternal, pregnancy and neonatal risk factors and significance for postmenstrual age at hospital discharge in moderately preterm infants that were exclusively or in part breast fed (n = 1857) and infants that were not breast fed (n = 197)* at discharge from hospital to home

	Exclusively or part breast feeding	No breast feeding
	Regression coefficient (p value)	Regression coefficient (p value)
Maternal age ⩾35 years	2.61 (<0.001)	3.04 (NS)
Multiplets	4.46 (<0.001)	3.06 (NS)
Gestational age at birth	−0.30 (0.092)	0.31 (NS)
Small for gestational age	5.41 (<0.001)	4.41 (NS)
Respiratory distress syndrome	3.21 (<0.001)	5.16 (0.038)
Infection	1.94 (0.004)	0.42 (NS)
Hypoglycaemia	2.10 (<0.001)	3.50 (NS)
Hyperbilirubinaemia	1.13 (0.013)	0.21 (NS)
Severe neonatal morbidity	9.80 (<0.001)	10.6 (NS)
Intercept (days)	264.7 (<0.001)	247.3 (<0.001)

Severe neonatal morbidity includes infants with one or more of the following diagnoses: retinopathy of prematurity grade 3–4, intraventricular haemorrhage grade 3–4 or bronchopulmonary dysplasia. A p value >0.05 was considered non-significant (NS).
R^2 in multivariate model for breastfed infants = 0.14 (p<0.001) and for not breastfed infants = 0.12 (p = 0.005).
*Some missing data on maternal age (n = 14/1857 and 3/197 in the breastfed and not breastfed group, respectively).

who did not breastfeed at hospital discharge. In addition, a majority of the preterm infants were exclusively breast fed before discharge, thereby allowing for discharge home as soon as physiological stability had been achieved.

As shown in this and previous studies, the LOS for preterm infants is much less influenced by morbidity and neonatal risk factors than expected.[6 29] There is general consensus that all preterm infants should have achieved physiological stability before they are sent home. But there are no accepted definitions of temperature and respiratory stability in Sweden. Accordingly, there could have been variations in the margins of safety—that is, the time elapsed after documented physiological temperature and respiratory stability, before discharge.[3] In a single-centre study, we have previously reported that the LOS for moderately preterm infants has been shortened over the past few years.[2] This result was not associated with any change in morbidity or GA over time. Therefore, we hypothesised that the introduction of domiciliary care and NIDCAP were in part responsible for the shorter LOS. Before the present study, there has been no report of LOS for preterm infants that includes specific organisational factors regarding care practice and availability to discharge with continued treatment.

Hospitalisation is stressful for both infants and parents. Therefore, the aim should always be to restrain the LOS as much as the medical condition and safety will allow.[30] Early hospital discharge has been reported to increase the risk of readmission for late preterm infants.[31] Domiciliary care could be a strategy to counteract such development. Beside the advantages already mentioned, early discharge has been associated with lower risk for nosocomial infection,[10] a better parental preparedness and a tendency to perceive the infants as being healthier.[32] Moreover, early discharge to domiciliary care has not been reported to increase readmissions.[10] Finally, in the present study, there was no mortality during domiciliary care (n = 110), but we have no other data on post-discharge mortality.

The strengths of this study are related to the PNQ register and sample size. As we cover a majority (63%) of all Swedish moderately preterm infants born during 2004–2005, there is enough power to exclude the influence of small random errors on the results. The PNQ register has provided us with almost complete data as reflected by very few (<1%) exclusions because of missing data. The register is based on standardised questionnaires filled out prospectively by physicians, which reduces the risks of recall and selection bias.

A limitation in the analyses of organisation is the low number of centres (n = 21). Another limitation is that there are no data on distance to NU from home,[6] workload or staff numbers in the NU,[5] factors that have been shown to influence discharge timing of moderately preterm infants. Finally, the register from which we extracted data did not contain information on the proportion of infants with apnoea of prematurity, which precludes an analysis of the effects of this diagnosis on PMA at discharge.

Moderately preterm infants represent a large proportion of all preterm infants and their numbers are increasing.[33] We need more information on their short-term and long-term outcomes and cost-effectiveness for medical care.[19 21 34] A considerable difference in LOS in moderately preterm infants probably exists between countries,[35] and more international comparisons would be of interest.

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REFERENCES

1. **Gray JE,** McCormick MC, Richardson DK, *et al*. Normal birth weight intensive care unit survivors: outcome assessment. *Pediatrics* 1996;**97**:832–8.
2. **Altman M,** Vanpee M, Bendito A, *et al*. Shorter hospital stay for moderately preterm infants. *Acta Paediatr* 2006;**95**:1228–33.
3. **Eichenwald EC,** Blackwell M, Lloyd JS, *et al*. Inter-neonatal intensive care unit variation in discharge timing: influence of apnea and feeding management. *Pediatrics* 2001;**108**:928–33.
4. **McCormick MC,** Escobar GJ, Zheng Z, *et al*. Place of birth and variations in management of late preterm (''near-term'') infants. *Semin Perinatol* 2006;**30**:44–7.
5. **Profit J,** McCormick MC, Escobar GJ, *et al*. Neonatal intensive care unit influences discharge of moderately preterm infants. *Pediatrics* 2007;**119**:314–9.
6. **Korvenranta E,** Linna M, Hakkinen U, *et al*. Differences in the length of initial hospital stay in very preterm infants. *Acta Paediatr* 2007;**96**:1416–20.
7. **Merritt TA,** Raddish M. A review of guidelines for the discharge of premature infants: opportunities for improving cost effectiveness. *J Perinatol* 1998;**18**:S27–37.
8. **Richardson DK,** Zupancic JA, Escobar GJ, *et al*. A critical review of cost reduction in neonatal intensive care. I. The structure of costs. *J Perinatol* 2001;**21**:107–15.
9. **Richardson DK,** Zupancic JA, Escobar GJ, *et al*. A critical review of cost reduction in neonatal intensive care. II. Strategies for reduction. *J Perinatol* 2001;**21**:121–7.
10. **Ortenstrand A,** Waldenstrom U, Winbladh B. Early discharge of preterm infants needing limited special care, followed by domiciliary nursing care. *Acta Paediatr* 1999;**88**:1024–30.
11. **Marsal K,** Persson PH, Larsen T, *et al*. Intrauterine growth curves based on ultrasonically estimated foetal weights. *Acta Paediatr* 1996;**85**:843–8.
12. **Stark AR.** Levels of neonatal care. *Pediatrics* 2004;**114**:1341–7.
13. **Collins CT,** Ryan P, Crowther CA, *et al*. Effect of bottles, cups, and dummies on breast feeding in preterm infants: a randomised controlled trial. *BMJ* 2004;**329**:193–8.
14. **Zupancic JA,** Richardson DK, O'Brien BJ, *et al*. Daily cost prediction model in neonatal intensive care. *Int J Technol Assess Health Care* 2003;**19**:330–8.
15. **Ringborg A,** Berg J, Norman M, *et al*. Preterm birth in Sweden: what are the average lengths of hospital stay and the associated inpatient costs? *Acta Paediatr* 2006;**95**:1550–5.
16. **Russell RB,** Green NS, Steiner CA, *et al*. Cost of hospitalization for preterm and low birth weight infants in the United States. *Pediatrics* 2007;**120**:e1–9.
17. **Kirkby S,** Greenspan JS, Kornhauser M, *et al*. Clinical outcomes and cost of the moderately preterm infant. *Adv Neonatal Care* 2007;**7**:80–7.
18. **Amiel-Tison C,** Allen MC, Lebrun F, *et al*. Macropremies: underprivileged newborns. *Ment Retard Dev Disabil Res Rev* 2002;**8**:281–92.
19. **Escobar GJ,** Clark RH, Greene JD. Short-term outcomes of infants born at 35 and 36 weeks gestation: we need to ask more questions. *Semin Perinatol* 2006;**30**:28–33.
20. **Raju TN,** Higgins RD, Stark AR, *et al*. Optimizing care and outcome for late-preterm (near-term) infants: a summary of the workshop sponsored by the National Institute of Child Health and Human Development. *Pediatrics* 2006;**118**:1207–14.
21. **Shapiro-Mendoza CK,** Tomashek KM, Kotelchuck M, *et al*. Risk factors for neonatal morbidity and mortality among ''healthy,'' late preterm newborns. *Semin Perinatol* 2006;**30**:54–60.
22. **Marret S,** Ancel PY, Marpeau L, *et al*. Neonatal and 5-year outcomes after birth at 30–34 weeks of gestation. *Obstet Gynecol* 2007;**110**:72–80.
23. **Shapiro-Mendoza CK,** Tomashek KM, Kotelchuck M, *et al*. Effect of late-preterm birth and maternal medical conditions on newborn morbidity risk. *Pediatrics* 2008;**121**:e223–32.
24. **Anderson JW,** Johnstone BM, Remley DT. Breast-feeding and cognitive development: a meta-analysis. *Am J Clin Nutr* 1999;**70**:525–35.
25. **Kramer MS,** Chalmers B, Hodnett ED, *et al*. Promotion of Breastfeeding Intervention Trial (PROBIT): a randomized trial in the Republic of Belarus. *JAMA* 2001;**285**:413–20.
26. **Akerstrom S,** Asplund I, Norman M. Successful breastfeeding after discharge of preterm and sick newborn infants. *Acta Paediatr* 2007;**96**:1450–4.
27. **Weiss M,** Ryan P, Lokken L, *et al*. Length of stay after vaginal birth: sociodemographic and readiness-for-discharge factors. *Birth* 2004;**31**:93–101.
28. **Howard CR,** Howard FM, Lanphear B, *et al*. Randomized clinical trial of pacifier use and bottle-feeding or cupfeeding and their effect on breastfeeding. *Pediatrics* 2003;**111**:511–8.
29. **Powell PJ,** Powell CV, Hollis S, *et al*. When will my baby go home? *Arch Dis Child* 1992;**67**:1214–6.
30. **Rose C,** Ramsay L, Leaf A. Strategies for getting preterm infants home earlier. *Arch Dis Child* 2008;**93**:271–3.
31. **Tomashek KM,** Shapiro-Mendoza CK, Weiss J, *et al*. Early discharge among late preterm and term newborns and risk of neonatal morbidity. *Semin Perinatol* 2006;**30**:61–8.
32. **Ortenstrand A,** Winbladh B, Nordstrom G, *et al*. Early discharge of preterm infants followed by domiciliary nursing care: parents' anxiety, assessment of infant health and breastfeeding. *Acta Paediatr* 2001;**90**:1190–5.
33. **Davidoff MJ,** Dias T, Damus K, *et al*. Changes in the gestational age among US singleton births: impact on rates of late preterm birth, 1992 to 2002. *Semin Perinatol* 2006;**30**:8–15.
34. **Zupancic JA,** Richardson DK, O'Brien BJ, *et al*. Cost-effectiveness analysis of predischarge monitoring for apnea of prematurity. *Pediatrics* 2003;**111**:146–52.
35. **Profit J,** Zupancic JAF, McCormick MC, *et al*. Moderately premature infants at Kaiser Permanente Medical Care Program in California are discharged home earlier than their peers in Massachusetts and the United Kingdom. *Arch Dis Child-Fetal Neonatal Ed* 2006;**91**:F245–F50.