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CLINICAL REPORT

Guidance for the Clinician in Rendering Pediatric Care

"Late-Preterm" Infants: A Population at Risk

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ABSTRACT

Late-preterm infants, defined by birth at 34⁰⁄₇ through 36⁶⁄₇ weeks' gestation, are less physiologically and metabolically mature than term infants. Thus, they are at higher risk of morbidity and mortality than term infants. The purpose of this report is to define "late preterm," recommend a change in terminology from "near term" to "late preterm," present the characteristics of late-preterm infants that predispose them to a higher risk of morbidity and mortality than term infants, and propose guidelines for the evaluation and management of these infants after birth.

INTRODUCTION

Infants born at 34⁰⁄₇ through 36⁶⁄₇ weeks' gestation, or "late-preterm" infants, are often the size and weight of some term infants (born at 37⁰⁄₇–41⁶⁄₇ weeks' gestation). Because of this fact, late-preterm infants may be treated by parents, caregivers, and health care professionals as though they are developmentally mature and at low risk of morbidity. They are often managed in newborn level 1 (basic) nurseries or remain with their mother after birth.[1]

Late-preterm infants are physiologically and metabolically immature.[2–8] As a consequence, late-preterm infants are at higher risk than are term infants of developing medical complications that result in higher rates of mortality and morbidity during the birth hospitalization.[6–8] In addition, late-preterm infants have higher rates of hospital readmission during the neonatal period than do term infants.[2,4,7–9] During the last 15 years, the proportion of all US births that were late preterm increased from 7.3% in 1990 to 9.1% in 2005.[10] In 2005, late-preterm births accounted for more than 70% of all preterm births (<37 weeks' gestation), or approximately 377 000 infants.[10–12] In fact, much of the increase in the preterm birth rate in recent years can be attributed to increases in late-preterm births.[12,13]

The reason for the increase in late-preterm births during the last decade is not well understood. One hypothesis is that it may be attributable, in part, to increased use of reproductive technologies and, as a result, an increase in multifetal pregnancies.[11,14–16] Another hypothesis is that advances in obstetric practice have led to an increase in surveillance and medical interventions during pregnancy.[11,14–17] As a result, fetuses considered to be at risk of stillbirth, including those with intrauterine growth restriction, fetal anomalies, and intrapartum asphyxia, may be identified earlier, which results in more deliveries at 34 to 36 weeks' gestation. For example, between 1989 and 2003, the use of electronic fetal monitoring and prenatal ultrasonography increased substantially from 68.1% to 85.4% and 47.6% to 67%, respectively.[10] Rates of labor induction and cesarean delivery also in-

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The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

Key Words
late preterm, near-term, moderate preterm, morbidity, mortality, readmission

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TABLE 1 Statistical and Conventional Definitions of Weeks of Gestation, Completed Weeks of Gestation, Late Preterm Gestation, and Term Gestation

	Gestation, wk	Gestation, Completed Weeks[a]							
Fraction of week[b]		0/7	1/7	2/7	3/7	4/7	5/7	6/7	
Statistical day[c]	0	0	1	2	3	4	5	6	1
Medical Convention day[d]		1	2	3	4	5	6	7	
	1	7	8	9	10	11	12	13	2
		8	9	10	11	12	13	14	
	33	231	232	233	234	235	236	237	34
		232	233	234	235	236	237	238	
	34	238	239	240	241	242	243	244	35
		239	240	241	241	243	244	245	
	35	245	246	247	248	249	250	251	36
		246	247	248	249	250	251	252	
	36	252	253	254	255	256	257	258	37
		253	254	255	256	257	258	259	
	37	259	260	261	262	263	264	265	38
		260	261	262	263	264	265	266	
	38	266	267	268	269	270	271	272	39
		267	268	269	270	271	272	273	
	39	273	274	275	276	277	278	279	40
		274	275	276	277	278	279	280	
	40	280	281	282	283	284	285	286	41
		281	282	283	284	285	286	287	
	41	287	288	289	290	291	292	293	42
		288	289	290	291	292	293	294	
	42	294	295	296	297	298	299	300	43
		295	296	297	298	299	300	301	

Late-preterm gestation is defined by medical convention as 34 0/7 weeks (239 days) through and including 36 6/7 weeks (259 days) after the beginning of the mother's last normal menstrual period. This is indicated in days with a red background. For comparison, term gestation spans from 37 0/7 weeks (260 days) through and including 41 6/7 weeks (294 days) after the beginning of the mother's last normal menstrual period, which is indicated in days with an aqua background.

[a] Completed week of gestation indicates the number of 7-day intervals that have passed since the beginning of the mother's last normal menstrual period. For example, the first completed week occurs after 1 seven-day interval (0 6/7th week or 7 days) has passed. The 37th completed week occurs after 37 seven-day intervals (36 6/7 weeks or 259 days) have passed.

[b] Fraction of a week indicates the days of each gestational week as a fraction. For example, the first day of gestation is the first day of the mother's 36 0/7th week of gestation and ends on the 36 6/7th week of gestation.

[c] Statistical day indicates that the first day of the mother's last menstrual period begins as day 0 and is not complete until the beginning of day 1.

[d] This statistical view of gestational age differs by 1 day from the conventional medical count of days, which indicates that the first day of the mother's last menstrual period begins as day 1. This important difference is indicated by the statistically defined days that have a gray background and conventionally defined days having no background or a red or aqua background.

creased during the last decade.[10,11] It is important to note, however, that the increased intensity of care provided to pregnant women has been accompanied by significant reductions in stillbirths, perinatal mortality, and births beyond 40 weeks' gestation.[11,14]

It is important to understand why these infants are being born early as well as the unique problems that this growing population of infants may experience. A clearer understanding of the underlying risk factors, associated etiologies, and their relative effects on delivery at 34 0/7

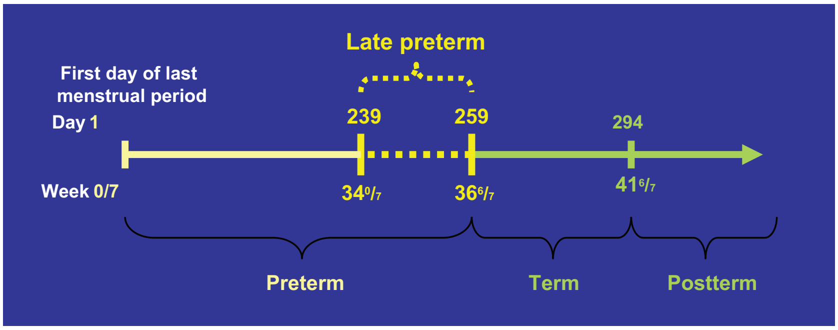

FIGURE 1
Late-preterm definition.

through 36 6/7 weeks' gestation on the mother and fetus is needed to develop interventions to prevent unnecessary late-preterm births and to improve the management of infants who are born late preterm. Thus, additional research is needed to determine the gestational age at delivery that optimally balances the risk of fetal morbidity or death against risks associated with late-preterm birth for both the mother and the fetus.

The purpose of this report is to define "late preterm," recommend a change in terminology to "late preterm" from the previously used "near term," describe the medical complications and health risks commonly encountered by late-preterm infants, suggest guidelines to identify and manage these complications and risks during the birth hospitalization and after discharge, and identify gaps in knowledge concerning the medical and developmental outcomes of these infants.

DEFINITION OF LATE PRETERM

The gestational age attributed to a newborn infant can be confusing, because the first day of a mother's last normal menstrual period is counted as either day 0 or day 1 depending on whether a statistical or conventional medical definition, respectively, is used. This difference in definition of gestational age accounts for a 1-day variation among data systems when determining the chronologic age of a newborn infant on the first day after birth (Table 1). The day of birth is counted as day 1 when using the conventional medical definition and day 0 when using the statistical definition. The use of conventional medical terminology is illustrated in the definitions of gestational age recommended by the American Academy of Pediatrics, the American College of Obstetricians and Gynecologists, and the World Health Organization.[18–20] For example, "preterm" is defined as birth that occurs on or before the end of the last day of the 37th completed week (ie, 36 6/7 weeks' gestation) after the onset of the mother's last menstrual period, which equates to 259 days in common medical terminology. The statistical definition for the last day of the 37th completed week of gestation is 258 days. Understanding these definitions is complicated further by financial systems that define the first day of age as delivery before 12:00 AM (midnight) and the subsequent day beginning immediately after 12:00 AM.

The use of the term "completed week" is also confusing. Completed weeks of gestation are defined by the number of 7-day intervals after the first day of the last menstrual period (Table 1).[5,20] For example, the end of the 37th completed week of gestation is 36 6/7 weeks' gestation, because 37 seven-day intervals (259 days) have transpired. To further clarify, the end of the 37th completed week is not 37 6/7 weeks' gestation; the beginning of the 38th week of gestation is designated as 37 0/7 weeks' gestation (260 days).[5,20]

A variety of terms have been used to describe preterm infants born at a number of different intervals between 32 and 37 weeks' gestation ("late preterm," "near term," "marginally preterm," "moderately preterm," "minimally preterm," and "mildly preterm").[2,6,12,21] In contrast, preterm, term, and postterm are mutually exclusive categories that have each been defined precisely according to week and day of gestation (counting the first day as day 1) by the American Academy of Pediatrics, the American College of Obstetricians and Gynecologists, and the World Health Organization (Fig 1).[18,19] As previously described, "preterm" is defined as a birth that occurs on or before the end of the last day of the 37th week (259th day) after the onset of the mother's last menstrual period. "Term" is defined as a birth that occurs on the first day (260th day) of the 38th week through the end of the last day of the 42nd week (294th day) after the onset of the last menstrual period (Table 1). "Postterm" describes the birth of an infant that occurs on or after the first day (295th day) of the 43rd week after the onset of the last menstrual period.

The 2005 workshop "Optimizing Care and Outcome of the Near-Term Pregnancy and the Near-Term Newborn Infant" sponsored by the National Institutes of Health recommended that infants born at 34 0/7 through 36 6/7 weeks' gestation after the onset of the mother's last menstrual period be referred to as late preterm to emphasize that these infants are preterm and, as such, are at risk of immaturity-related medical complications (Tables 2 and 3).[5] Furthermore, use of the term "near term," which connotes that the infant is almost term and,

TABLE 2 **Late-Preterm Infants and the Most Frequent Complications of Prematurity During the Birth Hospitalization**

Outcome During Initial Birth Hospitalization	Late-Preterm Morbidity		Term Morbidity		OR (95% CI)	*P*
	No.	%	No.	%		
Feeding difficulties						
Wang et al[2] (35–36 6/7 wk)	29	32.2	7	7.4	—	—
Hypoglycemia						
Wang et al[2] (35–36 6/7 wk)	14	15.6	5	5.3	3.30 (1.1–12.2)	.028
Jaundice						
Wang et al[2] (35–36 6/7 wk)	49	54.4	36	37.9	1.95 (1.04–3.67)	.027
Temperature instability						
Wang et al[2] (35–36 6/7 wk)	9	10.0	0	0.0	Infinite	.0012
Apnea						
Henderson-Smart[38] (34–35 6/7 wk)	—	7.0	—	<0.1	—	—
Merchant et al[42] (35–36 6/7 wk)	6	12.0	0	0.0	12.0 (4.5–24.3)	.0267
Wang et al[2] (35–36 6/7 wk)	4	4.0	0	0.0	—	.054
Respiratory distress						
Escobar et al[24] (34–36 6/7 wk)	345	10.7	975	2.7	—	—
Gilbert et al[70] (34–36 6/7 wk)	1167	3.6	843	0.8	—	—
Rubaltelli et al[33] (34–36 6/7 wk)	314	9.6	359	0.6	—	—
Wang et al[2] (35–36 6/7 wk)	26	28.9	4	4.2	9.14 (2.9–37.8)	.00001
Received intravenous infusion						
Wang et al[2] (35–36 6/7 wk)	24	26.7	5	5.3	6.48 (2.3–22.9)	.0007
Underwent sepsis evaluation						
Wang et al[2] (35–36 6/7 wk)	33	36.7	12	12.6	3.97 (1.8–9.2)	.00015
Received mechanical ventilation						
Gilbert et al[70] (34–36 6/7 wk)	1103	3.4	950	0.9	—	—

OR indicates odds ratio; CI, confidence interval; —, data not reported.

therefore, almost fully mature, should be discouraged, because it might lead health care professionals to underestimate the inherent risks to these infants.[5,20]

Workshop members acknowledged that the definition of "late preterm" was arbitrary.[5] The day after the end of the 34th completed week of gestation (ie, 239th day or 34 0/7 weeks' gestation after the onset of the mother's last menstrual period) was recommended as the lower limit, because it is frequently used as a cutoff point for obstetric decision-making, as a criterion for admission to a level 2 or 3 NICU, and for epidemiologic and clinical research. The upper limit of gestational age for prematurity was previously established as 36 6/7 weeks' gestation (259th day after the onset of the mother's last menstrual period). Thus, it was recommended that this same upper limit be applied to the late-preterm category of infants.

DEVELOPMENTAL AND PHYSIOLOGIC IMMATURITY OF LATE-PRETERM INFANTS

Late-preterm infants have not been studied frequently, and understanding of the developmental biology and mechanisms of disease experienced by these infants is largely incomplete.[2,5,7,8,22–30] Management strategies, therefore, are based on general principles, clinical experience, and extrapolation from knowledge of very preterm and term infants. Recently, descriptive studies that detailed the epidemiology, medical problems, and risk of mortality experienced by late-preterm infants have stimulated interest in exploring the comparative biology and basic mechanisms of disease in these infants.[2–8] Several important factors that may predispose late-preterm infants to medical conditions associated with immaturity, such as respiratory distress, apnea, temperature instability, hypoglycemia, hyperbilirubinemia, and poor feeding, are reviewed briefly in this report. However, a comprehensive review of the physiologic and functional deficits that predispose late-preterm infants to these conditions is beyond the scope of this report.[5]

After birth, infants with fetal lung structure and immature functional capacity are at greatest risk of respiratory distress, need for oxygen and positive-pressure ventilation, and admission for intensive care.[2,31–33] From 34 0/7 through 36 6/7 weeks' gestation, terminal respiratory units of the lung evolve from alveolar saccules lined with both cuboidal type II and flat type I epithelial cells (terminal sac period) to mature alveoli lined primarily with extremely thin type I epithelial cells (alveolar period).[34,35] During the alveolar period, pulmonary capillaries also begin to bulge into the space of each terminal sac, and adult pool sizes of surfactant are attained.[36] Functionally, this immature lung structure may be associated with delayed intrapulmonary fluid absorption, surfactant insufficiency, and inefficient gas exchange.[24,25]

Apnea occurs more frequently among late-preterm infants than term infants. The incidence of apnea in

TABLE 3 **Late-Preterm Infants and Rates of Readmission to the Hospital After the Birth Hospitalization**

Description of Comparison Groups by Study	Readmitted to Hospital[a]		Required Hospital Care[b]		Adjusted OR (95% CI)
	No.	%	No.	%	
All NICU survivors from 6 Kaiser Permanente hospitals, *N* = 6054 (Escobar et al[66])					
<33 wk, all LOS	20	3.4	—	—	1.88 (1.10–3.21)
33–36 wk, LOS < 96 h	31	5.7	—	—	2.94 (1.87–4.62)
33–36 wk, LOS ≥ 96 h	26	2.2	—	—	1.13 (0.69–1.84)
Term, LOS ≥ 96 h	32	2.8	—	—	1.31 (0.83–2.05)
Term, LOS < 96 h	56	2.2	—	—	Reference
One half of all births >34 wk born in UK northern region, *N* = 11406 (Oddie et al[4])					
35–37 wk	37	6.3	—	—	1.72 (1.15–2.57)
>40 wk	57	2.4	—	—	0.70 (0.51–0.95)
38–40 wk	178	3.4	—	—	Reference
All newborns surviving to discharge at 7 Kaiser Permanente hospitals, *N* = 33 276 (Escobar et al[3])					
<34 wk (100% in NICU)	26	3.0	—	—	0.96 (0.57–1.62)
34–36 wk, in NICU ≥ 24 h					0.89 (0.54–1.46)
34–36 wk, in NICU < 24 h					1.31 (0.41–4.21)
34–36 wk, never in NICU					3.10 (2.38–4.02)
All 34- to 36-wk infants	94	4.4	—	—	
≥37 wk, in NICU ≥ 24 h					0.79 (0.52–1.21)
≥37 wk, in NICU < 24 h					1.43 (0.73–2.81)
≥37 wk, never in NICU					Reference
All ≥37-wk infants	618	2.0	—	—	
All Massachusetts newborns discharged early after vaginal delivery, *N* = 25 324 (Tomashek et al[8])					
34–36 wk	35	3.5	—	—	1.8 (1.3, 2.5)[c]
37–41 wk	489	2.0	—	—	Reference
34–36 wk	—	—	43	4.3	1.5 (1.1, 2.0)[c]
37–41 wk	—	—	648	2.7	Reference

OR, odds ratio; CI, confidence interval; LOS, length of stay; UK, United Kingdom; —, data not reported.

[a] Readmitted to hospital within 2 weeks after birth hospitalization discharge (Escobar et al[3,66]) and within first 28 days of life (Oddie et al[4] and Tomashek et al[8]).

[b] Required hospital care includes hospital inpatient readmission and observational stay visit during neonatal period.

[c] Shown are relative risks with confidence limits.

late-preterm infants is reported to be between 4% and 7%,[28,31,37,38] compared with less than 1% to 2% at term.[38,39] It is notable that the frequency of apneic events at term was determined by using data from cardiopulmonary monitoring of healthy infants in their homes. Apneic events were inapparent to caregivers and resolved spontaneously. The predisposition to apnea in late-preterm infants is associated with several underlying factors including increased susceptibility to hypoxic respiratory depression, decreased central chemosensitivity to carbon dioxide, immature pulmonary irritant receptors, increased respiratory inhibition sensitivity to laryngeal stimulation, and decreased upper airway dilator muscle tone.[31,38,40–42] It is also suspected that late-preterm infants may be at higher risk of centrally mediated apnea, because their central nervous systems are developmentally immature (ie, fewer sulci and gyri, less myelin) and their brains are approximately two thirds the size of a term infant's brain.[30]

Little is known about cardiovascular physiology and pathobiology in late-preterm infants; it is generally believed that structural and functional immaturity restricts the amount of cardiovascular reserve that is available during times of stress.[43,44] Immature cardiovascular function also may complicate recovery of the late-preterm infant with respiratory distress because of delayed ductus arteriosus closure and persistent pulmonary hypertension.[45]

An infant's response to cold exposure after birth is related to gestational age and is affected by the physical size, the amount of mature brown and white adipose tissue, and maturity of the hypothalamus.[46–48] Brown-fat accumulation and maturation and concentrations of hormones responsible for brown-fat metabolism (eg, prolactin, leptin, norepinephrine, triiodothyronine, cortisol) peak at term.[49,50] Thus, late-preterm infants have less white adipose tissue for insulation, and they cannot generate heat from brown adipose tissue as effectively as infants born at term. In addition, late-preterm infants are likely to lose heat more readily than term infants, because they have a larger ratio of surface area to weight and are smaller in size.

Hypoglycemia may affect fasting newborn infants of all gestational ages because of insufficient metabolic responses to the abrupt loss of the maternal glucose supply after birth.[51–55] The incidence of hypoglycemia is inversely proportional to gestational age. Within the first 12 to 24 hours after birth, concentrations of enzymes that are essential for hepatic gluconeogenesis and hepatic ketogenesis rapidly increase. Thereafter, hypoglycemia typically resolves. Preterm infants are at increased risk of developing hypoglycemia after birth, because they have immature hepatic glycogenolysis and adipose tissue lipolysis, hormonal dysregulation, and deficient hepatic gluconeogenesis and ketogenesis. Blood glucose concentrations among preterm infants typically decrease to a nadir 1 to 2 hours after birth and remain low until metabolic pathways can compensate or exogenous sources of glucose are provided.[51,54] Carbohydrate metabolism among late-preterm infants is not well understood. However, immature glucose regulation likely occurs in late-preterm infants, because hypoglycemia that requires glucose infusion during the initial birth hospitalization occurs more frequently than in term infants.[2]

Jaundice and hyperbilirubinemia occur more commonly and are more prolonged among late-preterm infants than term infants, because late-preterm infants have delayed maturation and a lower concentration of uridine diphosphoglucuronate glucuronosyltransferase.[21,56] Late-preterm infants are 2 times more likely than term infants to have significantly elevated bilirubin concentrations and higher concentrations 5 and 7 days after birth.[21]

Late-preterm infants also have immature gastrointestinal function[57,58] and feeding difficulties that predispose them to an increase in enterohepatic circulation, decreased stool frequency, dehydration, and hyperbilirubinemia.[59–68] Feeding during the birth hospitalization may be transiently successful but not sustained after discharge. Feeding difficulties in late-preterm infants that are associated with relatively low oromotor tone, function, and neural maturation also predispose these infants to dehydration and hyperbilirubinemia.[30,67–69]

MORBIDITY AND MORTALITY AMONG LATE-PRETERM INFANTS

Late-preterm infants are at increased risk of neonatal morbidity compared with term infants. During the initial birth hospitalization, late-preterm infants are 4 times more likely than term infants to have at least 1 medical condition diagnosed and 3.5 times more likely to have 2 or more conditions diagnosed.[2] Late-preterm infants are more likely than term infants to be diagnosed during the birth hospitalization with temperature instability,[2] hypoglycemia,[2] respiratory distress,[2,24,33,70,71] apnea,[38,42] jaundice,[2] and feeding difficulties[2] (Table 2). During the first month after birth, late-preterm infants are also more likely than term infants to develop hyperbilirubinemia[21,60,72,73] and to be readmitted for hyperbilirubinemia[3,59,64] and non–jaundice-related diagnoses such as feeding difficulties and "rule-out sepsis."[3]

Some of the reported increase in morbidity among late-preterm infants may be attributable to observation and detection bias, because a clinician's threshold to monitor late-preterm infants for medical complications may be lower than their threshold for term infants. For example, a hospital-based study found that late-preterm infants were evaluated for possible sepsis 3 times as often as term infants, and the majority of evaluated late-preterm infants received antibiotic treatment, whereas term infants did not.[2] However, studies have also found that late-preterm infants are at increased risk of developing more severe illness than term infants.[2,24,70] One study of all California singleton live births who survived to 1 year of age found that infants born at 34 to 36 weeks' gestation were 3 to 9 times more likely to require mechanical ventilation than infants born at 38 weeks' gestation.[70] Late-preterm infants are also more likely than term infants to have longer initial hospital stays and to be admitted to the NICU.[2,3,33,70] One large cohort study found that 88% of infants born at 34 weeks' gestation, 54% of infants born at 35 weeks' gestation, 25% of infants born at 36 weeks' gestation, 12% of infants born at 37 weeks' gestation, and 2.6% of infants born at 38 through 40 weeks' gestation were admitted to a NICU.[3]

Severity of illness is also reflected in the increased risk of mortality among late-preterm infants compared with term infants in the United States.[6,10] In 2002, the neonatal mortality rate (deaths among infants 0–27 days' chronologic age) for late-preterm infants was 4.6 times higher than the rate for term infants (4.1 vs 0.9 per 1000 live births, respectively). This difference in neonatal mortality has widened slightly since 1995, when there was a fourfold difference in rates between late-preterm and term infants (4.8 vs 1.2 per 1000 live births, respectively). The infant mortality rate was also higher among late-preterm infants than term infants in 2002 (7.7 vs 2.5 per 1000 live births, respectively). This threefold difference has remained relatively constant since 1995, at which time the infant mortality rate was 9.3 per 1000 live births among late-preterm infants and 3.1 per 1000 live births among term infants.

Several case-control studies designed to evaluate risk factors for neonatal hospital readmission after the birth hospitalization have identified late-preterm birth as a significant risk factor.[62,63,65,68,74] Studies that compared neonatal hospital readmission rates among late-preterm infants and other groups of infants, including term infants, have found that late-preterm infants are more likely to be readmitted than are term infants (Table 3).[3,4,8,24,59] A large study in the United Kingdom found that infants born at 35 through 37 weeks' gestation were

1.7 times more likely to be readmitted during the neonatal period than were infants born at 38 through 40 weeks' gestation (adjusted odds ratio: 1.7; 95% confidence interval: 1.2–2.6).[4] A retrospective cohort study of all newborn infants who survived to discharge at 7 hospitals within a large managed care organization found that 4.4% of all late-preterm infants were readmitted within 2 weeks after the birth hospitalization, compared with 3.0% of infants less than 34 weeks' gestation and 2.0% of infants born at or after 37 weeks' gestation.[3] Late-preterm infants who were never admitted to the NICU were at the highest risk of rehospitalization. This study also found that having a home visit or a scheduled outpatient visit within 72 hours after discharge was associated with a decreased risk of rehospitalization. In addition, a population-based study found that late-preterm infants who were not admitted to the NICU after birth were 2 to 3 times more likely than term infants to be rehospitalized for hyperbilirubinemia.[59]

Late-preterm infants with short NICU stays may be at increased risk of hospital readmission after the birth hospitalization compared with all other NICU survivors. A study that assessed outcomes among all newborn infants discharged alive from 6 NICUs within a large managed care organization found that preterm infants of 33 to 36 weeks' gestation with a hospital stay of less than 4 days had higher hospital readmission rates than all other groups, including the most preterm group.[66] The reason for readmission for the majority of these late-preterm infants was jaundice (71%), followed by suspected sepsis (20%) and feeding difficulties (16%).

Late-preterm infants who are discharged early (<2-night hospital stay) from the hospital after a vaginal delivery may be at increased risk of neonatal morbidity compared with term infants who are discharged early.[8] A population-based study that compared rates of postdischarge neonatal morbidity between singleton late-preterm and term infants who were discharged early found that 4.3% and 2.7% of infants, respectively, were either readmitted or had an observational stay; 3.5% and 2.0%, respectively, were readmitted. Jaundice and infection accounted for 77.1% of readmissions among late-preterm infants and 60.3% of readmissions among term infants. In this study, breastfed late-preterm infants were 1.8 times more likely to require hospital-related care and 2.2 times more likely to be readmitted than breastfed term infants. In contrast, there was no difference in need for subsequent hospital-related care or readmission between nonbreastfed late-preterm and term infants.

Several factors have been identified to be associated with an increased risk of hospital readmission, an observational hospital stay, or severe morbidity among late-preterm infants. A population-based cohort study of healthy, singleton late-preterm infants delivered vaginally in Massachusetts hospitals between 1998 and 2002 found that 6.1% received hospital care after the birth hospitalization or died during the neonatal period.[7] Risk factors for requiring hospital care or experiencing morbidity included being the first born, being breastfed at discharge, having a mother who had labor and delivery complications, being a recipient of public insurance at delivery, or being of Asian/Pacific Island descent.[7,9]

Although it is known that late-preterm infants are at increased risk compared with term infants for infant mortality, morbidity during the initial birth hospitalization, and neonatal morbidity that requires hospital readmission, the long-term health consequences of being born late preterm are not yet known.[75] Small clinical reports that compared late-preterm infants with term infants suggested a higher risk of cerebral palsy,[76] speech disorders,[77,78] neurodevelopmental handicaps,[78] behavioral abnormalities,[79] and competence (behavioral, scholastic, social, and global).[75,79–81] Given that late-preterm infants are born before their nervous systems have fully developed, large population studies that evaluate long-term neurodevelopmental and behavioral outcomes of these children are needed.[75]

The emotional, personal, and financial costs to individuals, family, and society associated with late-preterm births have not been sufficiently described.[82] A conservative estimate for the long-term medical, educational, and productivity costs associated with the birth of all infants before 37 weeks' gestation is approximately $51 600 for each infant or a total cost of $26.2 billion in 2005 dollars. Individual late-preterm infants, on average, require fewer financial and other resources than infants who are born more preterm. However, the total resources and costs associated with late-preterm birth are likely to be a relatively substantial part of the total cost of all preterm births, because the population of late-preterm infants is significantly larger than the population of infants who are born before 34 weeks' gestation.

Collaborative counseling by neonatal and obstetric clinicians about fetal, neonatal, and maternal outcomes is warranted when maternal or fetal conditions indicate the necessity for late-preterm birth. The obstetric clinician can discuss the indications for the delivery and the risks inherent in delaying delivery. The neonatal clinician can provide the family with gestational age-specific outcome information and help prepare the family for the newborn infant's anticipated course in the nursery. Collaborative counseling allows the family to be fully informed and to participate in decision-making. Under emergent conditions, the time to provide such counseling may not exist.

SUMMARY

1. Late-preterm infants are immature.
   a. Infants born at 34 0/7 through 36 6/7 weeks' gestation (239–259 days since the first day of the last

menstrual period) should be referred to as "late preterm."

   b. Late-preterm infants are physiologically immature and have limited compensatory responses to the extrauterine environment compared with term infants.

2. Late-preterm infants are at a greater risk of morbidity and mortality than are term infants.

   a. During the birth hospitalization, late-preterm infants are more likely than are term infants to be diagnosed with temperature instability, hypoglycemia, respiratory distress, apnea, jaundice, or feeding difficulties.

   b. During the first month after birth, late-preterm infants are more likely than term infants to be rehospitalized for jaundice, feeding difficulties, dehydration, and suspected sepsis.

3. Risk factors that have been identified for rehospitalization or neonatal morbidity among late-preterm infants include being the first born, being breastfed at discharge, having a mother who had labor and delivery complications, being a recipient of public insurance at delivery, and being of Asian/Pacific Island descent.

4. Collaborative counseling by both obstetric and neonatal clinicians about the outcomes of late-preterm births is warranted unless precluded by emergent conditions.

Gaps in Knowledge, Clinical Implications, and Research Implications for Late-Preterm Births

The following are areas in which knowledge and research need to be expanded:

1. causes for delivery and short-term fetal, neonatal, and maternal outcomes;
2. developmental immaturity and mechanisms of disease in late-preterm infants;
3. identification tools, educational programs, and screening strategies to identify risk factors and prevent potential medical complications of late-preterm births;
4. recommendations for discharge, early follow-up evaluation, and treatment for jaundice, poor feeding, dehydration, and other complications in late-preterm infants; and
5. long-term medical, neurologic, and developmental outcomes for late-preterm infants.

Recommended Minimum Criteria for Discharge of Late-Preterm Infants

Discharge criteria for late-preterm infants have similarities to criteria developed for both high-risk infants and healthy term infants.[82] Because late-preterm infants are at greater risk of neonatal morbidity and mortality than are term infants, parents of late-preterm infants may need special instruction and guidance before hospital discharge and closer follow-up after discharge. Late-preterm infants who have risk factors for morbidity that requires hospital care (ie, hospital readmission), such as those who are breastfed or are first born, are most vulnerable. It is especially important to educate first-time mothers of late-preterm infants how to evaluate feeding success and what signs to look for to detect dehydration and hyperbilirubinemia. In some circumstances, this education may require a longer birth hospitalization.

Recommended criteria for discharge of late-preterm infants are intended to reflect evidence of physiologic maturity; feeding competency; thermoregulation; maternal education; assessment and planned interventions for medical, family, environmental, and social risk factors; and follow-up arrangements.

Minimum discharge criteria for late-preterm infants are as follows:

1. Accurate gestational age has been determined.[83,84]
2. Timing of discharge is individualized and based on feeding competency, thermoregulation, and absence of medical illness and social risk factors (see below). Late-preterm infants usually are not expected to meet the necessary competencies for discharge before 48 hours of birth.[85]
3. A physician-directed source for continued medical care (ie, medical home) has been identified, with a follow-up visit arranged for 24 to 48 hours after hospital discharge. Additional visits may be indicated until an established and maintained pattern of weight gain has been demonstrated.[86,87]
4. Vital signs should be documented as being within reference ranges and stable for the 12 hours preceding discharge, including a respiratory rate of less than 60 breaths per minute, a heart rate of 100 to 160 beats per minute, and axillary temperature of 36.5 to 37.4°C (97.7–99.3°F) measured in an open crib with appropriate clothing.[85]
5. At least 1 stool has been passed spontaneously.[85]
6. Twenty-four hours of successful feeding, either at the breast or with a bottle, and the ability to coordinate sucking, swallowing, and breathing while feeding has been demonstrated. Any infant with a weight loss of more than 2% to 3% of birth weight per day or a maximum of 7% of birth weight during the birth hospitalization should be assessed for evidence of dehydration before discharge.[85,88–90]
7. A formal evaluation of breastfeeding, including observation of position, latch, and milk transfer, has been undertaken and documented in the chart by trained caregivers at least twice daily after birth.[90,91]

8. A feeding plan has been developed and is understood by the family.[86]
9. A risk assessment for the development of severe hyperbilirubinemia has been performed and appropriate follow-up has been arranged.[88]
10. Physical examinations of the infant reveal no abnormalities that require continued hospitalization.[85]
11. There is no evidence of active bleeding at the circumcision site for at least 2 hours.[85]
12. Maternal and infant test results are available and have been reviewed, including blood test results for maternal syphilis and hepatitis B surface-antigen status; cord or infant blood type and direct Coombs test results, as clinically indicated; and results of screenings performed in accordance with state regulations, including screening for HIV infection.[85,92]
13. Initial hepatitis B vaccine has been administered or an appointment has been scheduled for its administration, and the importance of immunizations has been stressed.[85]
14. Metabolic and genetic screenings have been performed in accordance with state requirements. If a newborn screening is performed before 24 hours of milk feeding, a system for repeating the screening must be in place in accordance with state policy.[93]
15. A car safety seat study completed by a trained professional to observe for apnea, bradycardia, or oxygen desaturation has been passed.[94]
16. Hearing assessment has been performed and the results have been documented in the medical chart. Results have been discussed with family or caregivers. If follow-up is needed, follow-up plans have been outlined.[95]
17. Family, environmental, and social risk factors have been assessed. When risk factors are identified, the discharge should be delayed until they are resolved or a plan to safeguard the infant is in place. Such risk factors may include but are not limited to:
    a. untreated parental substance use or positive toxicology test results in the mother or newborn infant;
    b. history of child abuse or neglect;
    c. mental illness in a parent in the home;
    d. lack of social support, particularly for single, first-time mothers;
    e. homelessness, particularly during this pregnancy;
    f. ongoing or established risk of domestic violence; or
    g. adolescent mother, particularly if other risk factors are present.[85]
18. The mother and caregivers have received information or training or have demonstrated competency in the following:
    a. infant's hospital course and current condition;
    b. expected pattern of urine and stool frequency for the breastfeeding or formula-fed neonate (verbal and written instruction is recommended);
    c. umbilical cord, skin, and newborn genital care;
    d. hand hygiene, especially as a means to reduce the risk of infection;
    e. use of a thermometer to assess an infant's axillary temperature;
    f. assessment and provision of appropriate layers of clothing;
    g. identification of common signs and symptoms of illness, such as hyperbilirubinemia, sepsis, and dehydration;
    h. assessment for jaundice;
    i. provision of a safe sleep environment, including positioning the infant on his or her back during sleep[96];
    j. newborn safety issues including car safety seat use, need for smoke/fire alarms, and hazards of secondhand tobacco smoke and environmental pollutants;
    k. appropriate responses to a complication or an emergency; and
    l. sibling interactions and appropriate inclusion in care responsibilities.

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''Late-Preterm'' Infants: A Population at Risk

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