Policy of the American Academy of Pediatrics

Neonatal Care

A Compendium of AAP Clinical Practice Guidelines and Policies

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

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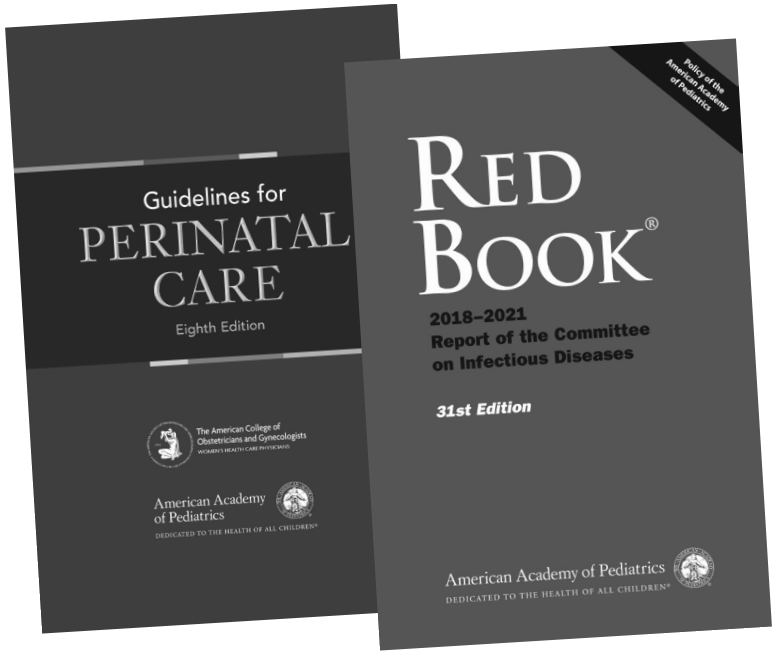
INTRODUCTION

Clinical practice guidelines have long provided physicians with evidence-based decision-making tools for managing common pediatric conditions. Policy statements issued by the American Academy of Pediatrics (AAP) are developed to provide physicians with a quick reference guide to the AAP position on child health care issues. We have combined these 2 authoritative resources into 1 comprehensive manual to provide easy access to important clinical and policy information.

This manual contains an AAP clinical practice guideline, as well as AAP policy statements, clinical reports, and technical reports related to neonatal care.

Additional information about AAP policy can be found in a variety of professional publications such as *Guidelines for Perinatal Care,* 8th Edition; *Red Book®,* 31st Edition; and *Red Book® Online* (http://redbook.solutions.aap.org).



AMERICAN ACADEMY OF PEDIATRICS

The American Academy of Pediatrics (AAP) and its member pediatricians dedicate their efforts and resources to the health, safety, and well-being of infants, children, adolescents, and young adults. The AAP has approximately 67,000 members in the United States, Canada, and Latin America. Members include pediatricians, pediatric medical subspecialists, and pediatric surgical specialists.

Core Values. ***We believe***

- In the inherent worth of all children; they are our most enduring and vulnerable legacy.
- Children deserve optimal health and the highest quality health care.
- Pediatricians, pediatric medical subspecialists, and pediatric surgical specialists are the best qualified to provide child health care.
- Multidisciplinary teams, including patients and families, are integral to delivering the highest quality health care.
- The AAP is the organization to advance child health and well-being and the profession of pediatrics.

Vision. Children have optimal health and well-being and are valued by society. American Academy of Pediatrics members practice the highest quality health care and experience professional satisfaction and personal well-being.

Mission. The mission of the AAP is to attain optimal, physical, mental, and social health and well-being for all infants, children, adolescents, and young adults. To accomplish this mission, the AAP shall support the professional needs of its members.

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FOREWORD

The core mission of the American Academy of Pediatrics (AAP) is "to attain optimal physical, mental, and social health and well-being for all infants, children, adolescents, and young adults." In order to reach these goals, the AAP advocates for the needs of children and supports the professional needs of its members who provide care to those children. With a commitment to evidence-based medicine, the AAP has established leadership entities—committee, councils, and sections—that are charged with providing policy, educational programming, and resources for AAP members.

The AAP Committee on Fetus and Newborn (COFN) is one of 26 AAP committees. Its members include academic newborn specialists from throughout the United States, as well as liaisons from the AAP Section on Neonatal-Perinatal Medicine, Centers for Disease Control and Prevention, National Association of Neonatal Nurses, Eunice Kennedy Shriver National Institutes of Child Health and Development, AAP Neonatal Resuscitation Program, Canadian Paediatric Society Fetus and Newborn Committee, and AAP Section on Surgery. COFN also works closely with the American College of Obstetricians and Gynecologists (ACOG) and includes a representative from the ACOG Committee on Obstetric Practice. Most recently, COFN has added a representative from the Neonatal-Perinatal Medicine Section Training and Early Career Neonatologists Council, as an educational and training opportunity for early career academic neonatologists. COFN is supported by AAP staff, including the Director of Hospital and Surgical Services and staff from the AAP Advocacy and External Affairs office.

The primary charge to COFN is the creation and revision of AAP policy statements, clinical reports, and technical reports. In many instances, this is done in collaboration with other AAP committees, councils, sections, or task forces. Oftentimes, COFN will reach out to external consultants for their expertise and review. Although COFN statements differ in content and purpose, they must all be evidence-based and formally developed. These statements and reports are intended to serve as clinical practice guidelines, to provide the pediatric provider with an organized, analytic framework for evaluating and treating common neonatal conditions. As noted in each COFN statement and report, they are not intended as an exclusive course of action or a standard of care. Rather, they represent expert review of all available data, evidence-based recommendations, and consensus where data may be lacking. AAP policy statements, clinical reports, and technical reports provide guidance, while allowing for flexibility in individual situations and encouraging sound clinical judgment.

Within this compendium, you will find the collected results of COFN efforts for the past several years, in addition to select policies from other AAP groups. A wide range of perinatal topics, from antenatal counseling for periviable gestations, to hospital discharge of the high-risk infant, to post-discharge follow-up of infants with congenital diaphragmatic hernia, is captured in these pages. More than 40 different topics, organized into 9 sections for easy reference, are included. Each statement or report contains an abstract overview, a concise presentation and critique of the available data, and a summary of the findings and/or recommendations, along with a current and comprehensive bibliography. It is important to note that COFN is continually working on new statements and reports, and each published statement or report is revised as new information becomes available.

As chairperson of COFN, I can attest to the hard work, dedication, and meticulous preparation that goes into each of the statements and reports presented in this compendium. As a practicing neonatologist, I guarantee that you will find this resource indispensable.

James J. Cummings, MD, MS, FAAP
Chairperson, AAP Committee on Fetus and Newborn

SECTION 1

Delivery/ Discharge

American Academy of Pediatrics
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POLICY STATEMENT

Hospital Discharge of the High-Risk Neonate

Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of All Children

Committee on Fetus and Newborn

ABSTRACT

This policy statement updates the guidelines on discharge of the high-risk neonate first published by the American Academy of Pediatrics in 1998. As with the earlier document, this statement is based, insofar as possible, on published, scientifically derived information. This updated statement incorporates new knowledge about risks and medical care of the high-risk neonate, the timing of discharge, and planning for care after discharge. It also refers to other American Academy of Pediatrics publications that are relevant to these issues. This statement draws on the previous classification of high-risk infants into 4 categories: (1) the preterm infant; (2) the infant with special health care needs or dependence on technology; (3) the infant at risk because of family issues; and (4) the infant with anticipated early death. The issues of deciding when discharge is appropriate, defining the specific needs for follow-up care, and the process of detailed discharge planning are addressed as they apply in general to all 4 categories; in addition, special attention is directed to the particular issues presented by the 4 individual categories. Recommendations are given to aid in deciding when discharge is appropriate and to ensure that all necessary care will be available and well coordinated after discharge. The need for individualized planning and physician judgment is emphasized. *Pediatrics* 2008;122:1119–1126

INTRODUCTION

The decision of when to discharge an infant from the hospital after a stay in the NICU is complex.[1] This decision is made primarily on the basis of the infant's medical status but is complicated by several factors. These factors include the readiness of families for discharge, differing opinions about what forms of care can be provided at home, and pressures to contain hospital costs by shortening the length of stay. Insofar as possible, determination of the readiness for discharge should be based on peer-reviewed scientific evidence. Shortening the length of a hospital stay may benefit the infant and family by decreasing the period of separation of infant and parents; moreover, the infant may benefit from shortening its exposure to the risks of hospital-acquired morbidity. However, the overriding concern is that infants may be placed at risk of increased mortality and morbidity by discharge before physiologic stability is established. Infants born preterm with low birth weight who require neonatal intensive care experience a much higher rate of hospital readmission and death during the first year after birth compared with healthy term infants.[2–5] Careful preparation for discharge and good follow-up after discharge may reduce these risks. It takes time for the family of a high-risk infant to prepare to care for their infant in a home setting and to obtain the necessary support services and mobilize community resources. With increased survival of very preterm and very ill infants, many infants are discharged with unresolved medical issues that complicate their subsequent care. Infants are often discharged requiring more care and closer follow-up than was typical in the past. In addition, societal and economic forces have come to bear on the timing and process of discharge and follow-up care. As a result, health care professionals need guidance in assessing readiness for discharge and planning for subsequent care. This policy statement, therefore, addresses 4 broad categories of high-risk infants: (1) the preterm infant; (2) the infant with special health care needs or dependence on technology; (3) the infant at risk because of family issues; and (4) the infant with anticipated early death. This policy statement updates a previous guideline published by the American Academy of Pediatrics in 1998.[1]

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Key Words
discharge, high risk, premature, neonate, infant

Abbreviation
SIDS—sudden infant death syndrome

CATEGORIES OF HIGH-RISK INFANTS

The Preterm Infant

Historically, preterm infants were discharged only when they achieved a certain weight, typically 2000 g (5 lb). However, randomized clinical trials[6–8] have shown that earlier discharge is possible without adverse health effects

when preterm infants are discharged on the basis of physiologic criteria rather than body weight. Although the population characteristics, the nature and results of the outcome measures, and the content of the early discharge programs in these studies varied, the common elements included:

- physiologic stability;
- an active program of parental involvement and preparation for care of the infant at home;
- arrangements for health care after discharge by a physician or other health care professional who is experienced in the care of high-risk infants; and
- an organized program of tracking and surveillance to monitor growth and development.

The 3 physiologic competencies that are generally recognized as essential before hospital discharge of the preterm infant are oral feeding sufficient to support appropriate growth, the ability to maintain normal body temperature in a home environment, and sufficiently mature respiratory control. These competencies are achieved by most preterm infants between 36 and 37 weeks' postmenstrual age,[7,9] but maturation of respiratory control to a point that allows safe discharge may take longer, occasionally up to 44 weeks' postmenstrual age.[10,11] Although interrelated, not all competencies are achieved by the same postnatal age in a given infant. The pace of maturation is influenced by the birth weight, the gestational age at birth, and the degree and chronicity of neonatal illnesses. Infants born earlier in gestation and with more complicated medical courses tend to take longer to achieve these physiologic competencies.

Home monitors are rarely indicated for detection of apnea solely because of immature respiratory control, in part because infants with immature respiratory control, in general, are still hospitalized until they are no longer at risk of apnea of prematurity. Use of a home monitor does not preclude the need for demonstrated maturity of respiratory control before discharge and should not be used to justify discharge of infants who are still at risk of apnea. Home monitors are not indicated for prevention of sudden infant death syndrome (SIDS) in preterm infants,[12] although preterm infants are at increased risk of SIDS.[13] Formal laboratory analyses of breathing patterns (ie, "pneumograms") are of no value in predicting SIDS[12] and are not helpful in identifying patients who should be discharged with home monitors.

Preterm infants should be placed supine for sleeping,[14–17] just as term infants should, and the parents of preterm infants should be counseled about the importance of supine sleeping in preventing SIDS. Hospitalized preterm infants should be kept predominantly in the supine position, at least from the postmenstrual age of 32 weeks onward, so that they become acclimated to supine sleeping before discharge. Supine positioning for sleep has led to an increase in positional skull deformity, especially in preterm infants but also in term infants[16,18,19]; although only cosmetic, these deformities can be quite disturbing to parents. Ways of safely preventing and treating deformation of the skull have been identified and are the subject of further investigation.[15,18,20]

Late-preterm infants, those born between 34 and 37 weeks' gestation, are at increased risk of having feeding problems and hyperbilirubinemia after discharge. These problems can be minimized but not wholly prevented by careful discharge planning and close follow-up after discharge.[21]

The Infant With Special Health Care Needs or Dependence on Technology

In recent years, increasing numbers of children with unresolved medical problems or special health care needs have been discharged requiring some form of supportive technology.[22] For newborn infants, the main types of technological support needed are nutritional support and respiratory support, including supplemental oxygen. This discussion will focus on nutritional and respiratory support, although other forms of home technological support are sometimes needed, including intravenous medications, bladder catheterization, and renal replacement therapy.

For most preterm infants and those with complex medical problems, oral feeding is best learned in the hospital under the care of expert physicians, nurses, and feeding therapists. Gavage feeding has been used safely in the home setting for infants who are not able to feed well enough by breast or bottle.[23–25] This practice has a limited role and should be considered only when feeding is the last issue requiring continued hospitalization. Not all parents are capable of safely managing home gavage feedings. When little or no progress is being made with oral feeding skills and long-term tube feeding seems inevitable, placement of a feeding gastrostomy tube provides another alternative method of feeding.[26] Unless precluded by neurologic deficits that threaten airway defense, oral feeding should be continued along with tube feeding so that oral feeding skills can continue to develop. Ordinarily, gavage or gastrostomy tube feedings are used to complement what is eaten orally to ensure adequate total intake. Home intravenous nutritional support is sometimes needed when enteral feeding is not possible or is limited by short-bowel syndrome or poor gastrointestinal function. Parenteral nutrition in the home requires careful assessment of the caregivers and home environment, thorough education of caregivers, and the support of a well-qualified home-care company.[27]

Home oxygen therapy for infants with bronchopulmonary dysplasia has been used as a means of achieving earlier hospital discharge while avoiding the risks of growth failure and cor pulmonale resulting from marginal oxygenation.[28–33] Sufficient oxygen should be delivered to maintain oxygen saturation at an acceptable level during a range of activities.[34–36] Infants who are discharged on supplemental oxygen are often also discharged on a cardiorespiratory monitor or pulse oximeter in case the oxygen should become dislodged or the supply depleted. Reducing or stopping supplemental oxygen should be supervised by the physician or other

health care professional and attempted only when the infant demonstrates normal oxygen saturation, good growth velocity, and sufficient stamina for a full range of activity.[36] Tracheostomy is sometimes required for neonates with upper airway abnormalities or occasionally for infants who cannot be weaned from assisted ventilation.[37–40] Good parental teaching and coordinated multidisciplinary follow-up care are essential for these infants. Infants who require home ventilation should also be on a cardiorespiratory monitor in case the airway should become obstructed, but the home ventilator should also have a disconnect alarm to alert caregivers to ventilator disconnection. Home ventilation requires qualified personnel to provide bedside care; in most cases, home-nursing support will be needed for at least part of the day.

The Infant at Risk Because of Family Issues

Preterm birth and prolonged hospitalization are known family stressors and risk factors for subsequent family dysfunction and child abuse.[41–43] In addition to preterm birth and prolonged hospital stay, birth defects and disabling conditions are also risk factors.[44] Maternal factors include lower educational level, lack of social support, marital instability, and fewer prenatal care visits.[41,42] In 1 study, significantly fewer family visits during the stay in the NICU had occurred for infants in whom subsequent maltreatment was documented.[41] Parental substance abuse is another factor that places the infant at risk, both because of adverse effects on the developing fetus in utero and because of possible postnatal exposure to drugs through breastfeeding or by inhalation. Moreover, the drug-seeking behaviors of parents may compromise the safety of the child's environment. Sequelae such as attachment disturbances, behavioral and developmental disorders, and child maltreatment have been observed frequently among children born to substance abusers.

Identifying effective strategies to help protect the infant who is at increased risk because of family reasons has been elusive. Most interventions have focused on multidisciplinary teams that provide follow-up monitoring, including home visits.[45] However, the efficacy of these interventions has been difficult to demonstrate. At the very least, it is hoped that an organized approach to planning for discharge can identify infants who require extra support or whose home environments present unacceptable risks.

The Infant With Anticipated Early Death

For many infants with incurable, terminal disorders, the best place to spend the last days or weeks of life is at home.[46] In these situations, the family provides most of the care, often with support by staff from a community hospice organization. In rare instances, withdrawal of assisted ventilation can occur in the home.[47] In preparing to discharge an infant for home hospice care, several aspects must be considered in addition to the usual factors.[48] These preparations include arrangements for medical follow-up and home-nursing visits; management of pain and other distressing symptoms; arrangements for home oxygen or other equipment and supplies; providing the family with information on bereavement support for the parents, siblings, and others; discussion of possible resources for respite of caregivers; and assistance in addressing financial issues. If appropriate, a letter should be provided for the family to show to other caregivers or emergency medical workers indicating that the child should not be resuscitated. The focus of planning efforts should be to enhance the quality of the infant's remaining life for the benefit of both the infant and his or her family.

TIMING OF DISCHARGE

The appropriate time for discharge is when the infant demonstrates the necessary physiologic maturity (in the case of the preterm infant), discharge planning and arrangements for follow-up and any home care have been completed, and the parents have received the necessary teaching and have demonstrated their mastery of the essential knowledge and skills. In selected cases, an infant may be discharged before one of the infant's physiologic competencies has been met, provided the health care team and the parents agree that this is appropriate and suitable plans have been made to provide additional support needed to ensure safe care at home, such as tube feeding, cardiorespiratory monitoring, or home oxygen. The standard, default criterion remains that the infant should be sufficiently mature to need no such assistance at home. The decision to facilitate earlier discharge by providing such additional support should be made only as a mutual decision by the health care team and the parents.

Before discharge, the eyes of qualifying infants should be examined at specified times by an ophthalmologist with expertise in the diagnosis of retinopathy of prematurity.[49] The infant's hearing should be evaluated[50,51]; the results of the newborn metabolic screen should be reviewed[52]; appropriate immunizations should be given, if not given previously; and palivizumab should be given to qualifying infants during respiratory syncytial virus season.[53,54]

Sometimes infants are transferred to a hospital closer to home so that the family may visit more easily. This is appropriate provided appropriate medical care is available in the receiving hospital, including capabilities for ophthalmologic examinations to screen for retinopathy of prematurity and the experience and resources for planning discharge and follow-up care.

DISCHARGE PLANNING

High-risk infants should receive primary medical care from a physician with expertise in the care of patients who have spent time in the NICU, often in partnership with 1 or more specialized clinics in the discharging medical center. To ensure continuity of care after discharge, infants with unresolved medical issues that persist after their hospital stay, such as bronchopulmonary dysplasia or feeding dysfunction, should be comanaged by a neonatologist or other medical subspecialist from the hospital at which most of the care was provided. The

subspecialist provides consultation to the primary physician about issues such as the weaning and discontinuation of supplemental oxygen. Most high-risk infants should also be enrolled in a follow-up clinic that specializes in the neurodevelopmental assessment of high-risk infants. This neurodevelopmental follow-up is sometimes integrated with the child's visits to the neonatologist. Standardized assessments should be performed in the follow-up clinic at specific ages through early childhood.[55–57]

The care of each high-risk neonate after discharge must be coordinated carefully to provide ongoing multidisciplinary support of the family. The discharge-planning team should include parents, the neonatologist, neonatal nurses and nurse practitioners, and the social worker. Other professionals, such as surgical specialists and pediatric medical subspecialists, respiratory, physical, occupational, and speech therapists, infant educators, nutritionists, home-health care company staff, and others may be included as needed.

Discharge planning should begin early in the hospital course. The goal of the discharge plan is to ensure successful transition to home care. Essential discharge criteria are a physiologically stable infant, a family who can provide the necessary care with appropriate support services in the community, and a primary care physician who is prepared to assume the responsibility with appropriate backup from specialist physicians and other professionals as needed.[55,56] Six critical components must be included in discharge planning.

1. Parental Education

Parental contact and involvement in the care of the infant should be encouraged from the time of admission. The participation of the parents in whatever way possible from the beginning has a positive effect on their confidence in handling the infant and readiness to assume full responsibility for the infant's care at home.

The development of an individualized teaching plan helps parents to acquire the skills and judgment needed to care for their infant. A written checklist or outline of the specific areas and tasks to be mastered increases the likelihood that parents and other caregivers will receive complete instructions and experience. Caregivers and parents must understand that the infant's immaturity and medical status will require increased care and vigilance at home beyond that of the usual parental role. Thus, ample time for teaching the parents and caregivers the techniques and the rationale for each item in the care plan is essential. Requesting return demonstrations by the parents of their new knowledge, parent rooming-in, and telephone follow-up by hospital staff all facilitate parental education and adaptation to their infant's care. Although it is important for the parents to understand that their child may need extra care and surveillance, the infant's fragility should not be overstated. If this occurs, the parents may become excessively protective, which can restrict the child's social development and lead to behavior problems.[58] Parents should be coached in communicating about the infant with any older siblings, who may not fully understand the infant's condition and may even imagine themselves to be responsible for the vulnerable state of their younger brother or sister.

Insofar as possible, at least 2 responsible caregivers should be identified and learn the necessary care for each infant. The demands of home care can be physically and emotionally draining, especially at first, for infants who require frequent feeding. Young mothers who do not live with a parent or the father of the infant have been shown to be especially vulnerable to the strains of home care. Even in a 2-parent family, the primary caregiver may become ill and need relief.

2. Completion of Appropriate Elements of Primary Care in the Hospital

Preparing the infant for transition to primary care begins early in the hospitalization with administration of immunizations at the recommended postnatal ages, regardless of prematurity or medical condition,[59] completion of metabolic screening,[52] assessment of hearing by an acceptable electronic measurement,[50,51] and baseline neurodevelopmental and neurobehavioral assessment. For infants at risk, appropriate funduscopic examination for retinopathy of prematurity should be performed by an ophthalmologist who is skilled in the evaluation of the retina of the preterm infant.[49] Assessment of hematologic status is recommended for all infants because of the high prevalence of anemia after neonatal intensive care. Very preterm infants and those who have received parenteral nutrition for prolonged periods may be at risk of hypoproteinemia, vitamin deficiencies, and bone mineralization abnormalities; therefore, evaluation for nutritional or metabolic deficiencies may be indicated. When discharge is near, the high-risk infant should be evaluated to ensure physiologic stability in an appropriate car seat or car bed.[60–62]

3. Development of Management Plan for Unresolved Medical Problems

Review of the hospital course and the active problem list of each infant and careful physical assessment will reveal any unresolved medical issues and areas of physiologic function that have not reached full maturation. From such a review, the diagnostic studies required to document the current clinical status of the infant can be identified and management can be continued or adjusted as appropriate. The intent should be to ensure implementation of appropriate home-care and follow-up plans.

4. Development of the Comprehensive Home-Care Plan

Although the content of the home-care plan may vary with the infant's diagnoses and medical status, the common elements include (1) identification and preparation of the in-home caregivers, (2) formulation of a plan for nutritional care and administration of any required medications, (3) development of a list of required equipment and supplies and accessible sources, (4) identification and mobilization of the primary care physician, the necessary and qualified home-care personnel and community support services, (5) assessment of the adequacy of the physical facilities within the home, (6) development

of an emergency care and transport plan, and (7) assessment of available financial resources to ensure the capability to finance home-care costs. The input of the primary care physician in formulating the home-care plan of the technology-dependent infant is essential. Many infants, particularly extremely preterm and technology-dependent infants, require continued care by multiple specialists and subspecialists, who should be included in the predischarge assessment and discharge planning.

5. Identification and Involvement of Support Services

The infant's optimal outcome ultimately depends on the capacity and effort of the family. The psychological, social, economic, and educational condition and needs of the family should be addressed from the beginning of the infant's hospitalization, noting strengths that can support the infant's continued adaptation, growth, and development and any risk factors that may contribute to an adverse infant outcome. The availability of social support is essential for the success of every parent's adaptation to the home care of a high-risk infant. Before discharge and periodically thereafter, a review of the family's needs, coping skills, use of available resources, financial problems, and progress toward goals in the home care of their infant should be evaluated. After the social support needs of the family have been identified, an appropriate, individualized intervention plan using available community programs, surveillance, or alternative care placement of the child may be implemented.

6. Determination and Designation of Follow-Up Care

In general, the attending neonatologist or other discharging physician has the responsibility for coordination of follow-up care, although in some institutions this responsibility may be delegated to another professional. A primary care physician (or "medical home") should be identified well before discharge to facilitate the coordination of follow-up care planning between the staff responsible for planning the discharge and the primary health care professionals. Pertinent information about the nursery course, including a discharge summary, and the home-care plan should be given to the primary care physician before the infant's discharge. In specialty center units, the primary care attending physician should work with the neonatologist in coordinating the discharge planning.

Arrangements for an initial appointment with the primary care physician should be made before discharge. Specific follow-up appointments with each involved surgical specialist and pediatric medical subspecialist should be made, giving attention to grouping the appointments as much as possible for the convenience of the family. A plan should be developed and discussed for emergency care and transportation to a hospital, should it be necessary.

Periodic evaluation of the developmental progress of every infant is essential for identifying deviations in neurodevelopmental progress at the earliest possible point, thereby facilitating entry into early intervention programs. The primary care physician with appropriate skills, the pediatric medical subspecialist, or clinic personnel may provide longitudinal developmental follow-up. When need for input from multiple disciplines is identified before discharge, a clinic that provides multidisciplinary care, usually in an academic or tertiary center, may be the least cumbersome option for the family.

SPECIAL CONSIDERATIONS

Many infants are transported to hospitals nearer to their family homes for convalescent care. In these hospitals, the discharge-planning process should follow the same principles as those outlined previously in this statement for an infant being discharged from a subspecialty center. It is especially important that periodic examination by a qualified ophthalmologist be available for infants who still require evaluation for retinopathy of prematurity.

In caring for the discharged high-risk infant, use of community resources, both public and private, should be encouraged. The goal should be to provide coordinated care and family support. Efficient teamwork by health care professionals is imperative. Home-nursing visits are often indicated. When this is so, it is important to use experienced nurses who are qualified to perform the required assessments. When choosing a home-care company or agency for technology-dependent infants, it is essential that previous performance and existing quality-control programs be considered.

RECOMMENDATIONS

The following recommendations are offered as a framework for guiding decisions about the timing of discharge. It is prudent for each institution to establish guidelines that ensure a consistent approach yet allow some flexibility on the basis of physician and family judgment. It is of foremost importance that the infant, family, and community be prepared for the infant to be safely cared for outside the hospital.

Infant Readiness for Hospital Discharge

The infant is considered ready for discharge if, in the judgment of the responsible physician, the following have been accomplished:

- A sustained pattern of weight gain of sufficient duration has been demonstrated.
- The infant has demonstrated adequate maintenance of normal body temperature fully clothed in an open bed with normal ambient temperature (20–25°C).
- The infant has established competent feeding by breast or bottle without cardiorespiratory compromise.
- Physiologically mature and stable cardiorespiratory function has been documented for a sufficient duration.
- Appropriate immunizations have been administered.
- Appropriate metabolic screening has been performed.

- Hematologic status has been assessed and appropriate therapy has been instituted, if indicated.
- Nutritional risks have been assessed and therapy and dietary modification has been instituted, if indicated.
- Hearing evaluation has been completed.
- Funduscopic examinations have been completed, as indicated.
- Neurodevelopmental and neurobehavioral status has been assessed and demonstrated to the parents.
- Car seat evaluation has been completed.
- Review of the hospital course has been completed, unresolved medical problems have been identified, and plans for follow-up monitoring and treatment have been instituted.
- An individualized home-care plan has been developed with input from all appropriate disciplines.

Family and Home Environmental Readiness

Assessment of the family's caregiving capabilities, resource availability, and home physical facilities has been completed as follows:

- identification of at least 2 family caregivers and assessment of their ability, availability, and commitment;
- psychosocial assessment for parenting strengths and risks;
- a home environmental assessment that may include on-site evaluation; and
- review of available financial resources and identification of adequate financial support.

In preparation for home care of the technology-dependent infant, it is essential to complete an assessment documenting availability of 24-hour telephone access, electricity, safe in-house water supply, and adequate heating. Detailed financial assessment and planning are also essential. Parents and caregivers should have demonstrated the necessary capabilities to provide all components of care, including:

- feeding, whether by breast, bottle, or an alternative technique, including formula preparation, if required;
- basic infant care, including bathing; skin, cord, and genital care; temperature measurement; dressing; and comforting;
- infant cardiopulmonary resuscitation and emergency intervention;
- assessment of clinical status, including understanding and detection of the general early signs and symptoms of illness as well as the signs and symptoms specific to the infant's condition;
- infant safety precautions, including proper infant positioning during sleep and proper use of car seats or car bed;
- specific safety precautions for the artificial airway, if any; feeding tube; intestinal stoma; infusion pump; and other mechanical and prosthetic devices, as indicated;
- administration of medications, specifically proper storage, dosage, timing, and administration and recognition of potential signs of toxicity;
- equipment operation, maintenance, and problem solving for each mechanical support device required; and
- the appropriate technique for each special care procedure required, including special dressings for infusion entry site, intestinal stoma, or healing wounds; maintenance of an artificial airway; oropharyngeal and tracheal suctioning; and physical therapy, as indicated.

Specific modification of home facilities must have been completed if needed to accommodate home-care systems. Plans must be in place for responding to loss of electrical power, heat, or water and for emergency relocation mandated by natural disaster.

Community and Health Care System Readiness

An emergency intervention and transportation plan have been developed and emergency medical services providers have been identified and notified, if indicated.

Follow-up care needs have been determined, appropriate providers have been identified, and appropriate information has been exchanged, including the following:

- A primary care physician has been identified and has accepted responsibility for care of the infant.
- Surgical specialty and pediatric medical subspecialty follow-up care requirements have been identified and appropriate arrangements have been made.
- Neurodevelopmental follow-up requirements have been identified and appropriate referrals have been made.
- Home-nursing visits for assessment and parent support have been arranged, as indicated by the complexity of the infant's clinical status and family capability, and the home-care plan has been transmitted to the home health agency.
- For breastfeeding mothers, information on breastfeeding support and availability of lactation counselors has been provided.

The determination of readiness for care at home of an infant after neonatal intensive care is complex. Careful balancing of infant safety and well-being with family needs and capabilities is required while giving consideration to the availability and adequacy of community resources and support services. The final decision for discharge, which is the responsibility of the attending physician, must be tailored to the unique constellation of issues posed by each infant's situation.

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REFERENCES

1. American Academy of Pediatrics, Committee on Fetus and Newborn. Hospital discharge of the high-risk neonate: proposed guidelines. *Pediatrics.* 1998;102(2 pt 1):411–417
2. Hulsey TC, Hudson MB, Pittard WB III. Predictors of hospital postdischarge infant mortality: implications for high-risk infant follow-up efforts. *J Perinatol.* 1994;14(3):219–225
3. Lamarche-Vadel A, Blondel B, Truffert P, et al. Re-hospitalization in infants younger than 29 weeks' gestation in the EPIPAGE study. *Acta Paediatr.* 2004;93(10):1340–1345
4. Smith VC, Zupanic JA, McCormick MC, et al. Rehospitalization in the first year of life among infants with bronchopulmonary dysplasia. *J Pediatr.* 2004;144(6):799–803
5. Resch B, Pasnocht A, Gusenleitner W, Muller W. Rehospitalisations for respiratory disease and respiratory syncytial virus infection in preterm infants of 29–36 weeks gestational age. *J Infect.* 2005;50(5):397–403
6. Davies DP, Herbert S, Haxby V, McNeish AS. When should pre-term babies be sent home from neonatal units? *Lancet.* 1979;1(8122):914–915
7. Brooten D, Kumar S, Brown L, et al. A randomized clinical trial of early hospital discharge and home follow-up of very-low-birth-weight infants. *N Engl J Med.* 1986;315(15):934–939
8. Casiro OG, McKenzie ME, McFadyen L, et al. Earlier discharge with community-based intervention for low birth weight infants: a randomized trial. *Pediatrics.* 1993;92(1):128–134
9. Powell PJ, Powell CVE, Holli S, Robinson JM. When will my baby go home? *Arch Dis Child.* 1992;67(10 Spec No.): 1214–1216
10. Eichenwald EC, Aina A, Stark AR. Apnea frequently persists beyond term gestation in infants delivered at 24 to 28 weeks. *Pediatrics.* 1997;100(3 pt 1):354–359
11. Darnall RA, Kattwinkel J, Nattie C, Robinson M. Margin of safety for discharge after apnea in preterm infants. *Pediatrics.* 1997;100(5):795–801
12. American Academy of Pediatrics, Committee on Fetus and Newborn. Apnea, sudden infant death syndrome, and home monitoring. *Pediatrics.* 2003;111(4 pt 1):914–917
13. Thompson JMD, Mitchell EA; New Zealand Cot Death Study Group. Are the risk factors for SIDS different for preterm and term infants? *Arch Dis Child.* 2006;91(2):107–111
14. Øyen N, Markestad T, Skjærven R, et al. Combined effects of sleeping position and prenatal risk factors in sudden infant death syndrome: the Nordic Epidemiological SIDS Study. *Pediatrics.* 1997;100(4):613–621
15. American Academy of Pediatrics, Task Force on Infant Sleep Position and Sudden Infant Death Syndrome. Changing concepts of sudden infant death syndrome: implications for infant sleeping environment and sleep position. *Pediatrics.* 2000;105(3 pt 1):650–656
16. American Academy of Pediatrics, Task Force on Sudden Infant Death Syndrome. The changing concept of sudden infant death syndrome: diagnostic coding shifts, controversies regarding the sleeping environment, and new variables to consider in reducing risk. *Pediatrics.* 2005;116(5):1245–1255
17. Blair PS, Platt MW, Smith IJ, Fleming PJ; CESDI SUDI Research Group. Sudden infant death syndrome and sleeping position in pre-term and low birth weight infants: an opportunity for targeted intervention. *Arch Dis Child.* 2006;91(2): 101–106
18. Persing J; American Academy of Pediatrics, Committee on Practice and Ambulatory Medicine, Section on Plastic Surgery, and Section on Neurological Surgery. Prevention and management of positional skull deformities in infants. *Pediatrics.* 2003; 112(1 pt 1):199–202
19. Graham JM Jr, Kreutzman J, Earl D, Halberg A, Samayoa C, Guo X. Deformational brachycephaly in supine-sleeping infants. *J Pediatr.* 2005;146(2):253–257
20. Graham JM Jr, Gomez M, Halberg A, et al. Management of deformational plagiocephaly: repositioning versus orthotic therapy. *J Pediatr.* 2005;146(2):258–262
21. Engle WA, Tomashek KM, Wallman C; American Academy of Pediatrics, Committee on Fetus and Newborn. "Late-preterm" infants: a population at risk. *Pediatrics.* 2007;120(6):1390–1401
22. American Academy of Pediatrics, Section on Home Health Care. *Guidelines for Pediatric Home Health Care*. McConnell MS, Imaizumi SO, eds. Elk Grove Village, IL: American Academy of Pediatrics; 2002
23. Collins CT, Makrides M, McPhee AJ. Early discharge with home support of gavage feeding for stable preterm infants who have not established full oral feeds. *Cochrane Database Syst Rev.* 2003;(4):CD003743
24. Örtenstrand A, Waldenström U, Winbladh B. Early discharge of preterm infants needing limited special care, followed by domiciliary nursing care. *Acta Paediatr.* 1999;88(9):1024–1030
25. Örtenstrand A, Winbladh B, Nordström G, Waldenström U. Early discharge of preterm infants followed by domiciliary nursing care: parents' anxiety, assessment of infant health and breastfeeding. *Acta Paediatr.* 2001;90(10):1190–1195
26. Åvitsland TL, Kristensen C, Emblem R, Veenstra M, Mala T, Bjørnland K. Percutaneous endoscopic gastrostomy in children: a safe technique with major symptom relief and high parental satisfaction. *J Pediatr Gastroenterol Nutr.* 2006;43(5): 624–628
27. George DE; American Academy of Pediatrics, Section on Home Health Care. Home parenteral and enteral nutrition. In: McConnell MS, Imaizumi SO, eds. *Guidelines for Pediatric Home Health Care*. Elk Grove Village, IL: American Academy of Pediatrics; 2002:113–123
28. Pinney MA, Cotton EK. Home management of bronchopulmonary dysplasia. *Pediatrics.* 1976;58(6):856–859
29. Halliday HL, Dumpit FM, Brady JP. Effects of inspired oxygen

on echocardiographic assessment of pulmonary vascular resistance and myocardial contractility in bronchopulmonary dysplasia. *Pediatrics.* 1980;65(3):536–540
30. Groothuis JR, Rosenberg AA. Home oxygen promotes weight gain in infants with bronchopulmonary dysplasia. *Am J Dis Child.* 1987;141(9):992–995
31. Sekar KC, Duke JC. Sleep apnea and hypoxemia in recently weaned premature infants with and without bronchopulmonary dysplasia. *Pediatr Pulmonol.* 1991;10(2):112–116
32. Garg M, Kurzner SI, Bautista DB, Keens TG. Clinically unsuspected hypoxia during sleep and feeding in infants with bronchopulmonary dysplasia. *Pediatrics.* 1988;81(5):635–642
33. Moyer-Mileur LJ, Nielson DW, Pfeffer KD, Witte MK, Chapman DL. Eliminating sleep-associated hypoxemia improves growth in infants with bronchopulmonary dysplasia. *Pediatrics.* 1996;98(4 pt 1):779–783
34. Kotecha S, Allen J. Oxygen therapy for infants with chronic lung disease. *Arch Dis Child Fetal Neonatal Ed.* 2002;87(1): F11–F14
35. Allen J, Zwerdling R, Ehrenkranz R, et al. Statement on the care of the child with chronic lung disease of infancy and childhood. *Am J Respir Crit Care Med.* 2003;168(3):356–396
36. Pannitch H; American Academy of Pediatrics, Section on Home Health Care. Bronchopulmonary dysplasia. In: McConnell MS, Imaizumi SO, eds. *Guidelines for Pediatric Home Health Care*. Elk Grove Village, IL: American Academy of Pediatrics; 2002: 323–342
37. Quint RD, Chesterman E, Crain LS, Winkleby M, Boyce WT. Home care for ventilator-dependent children. *Am J Dis Child.* 1990;144(11):1238–1241
38. Storgion S; American Academy of Pediatrics, Section on Home Health Care. Care of children requiring home mechanical ventilation. In: McConnell MS, Imaizumi SO, eds. *Guidelines for Pediatric Home Health Care*. Elk Grove Village, IL: American Academy of Pediatrics; 2002:307–321
39. Edwards EA, O'Toole M, Wallis C. Sending children home on tracheostomy dependent ventilation: pitfalls and outcomes. *Arch Dis Child.* 2004;89(3):251–255
40. Edwards EA, Hsiao K, Nixon GM. Paediatric home ventilatory support: the Auckland experience. *J Paediatr Child Health.* 2005; 41(12):652–658
41. Hunter RS, Kilstrom N, Kraybill EN, Loda F. Antecedents of child abuse and neglect in premature infants: a prospective study in a newborn intensive care unit. *Pediatrics.* 1978;61(4): 629–635
42. Murphy JF, Jenkins J, Newcombe RG, Sibert JR. Objective birth data and the prediction of child abuse. *Arch Dis Child.* 1981;56(4):295–297
43. Spencer N, Wallace A, Sundrum R, Bacchus C, Logan S. Child abuse registration, fetal growth, and preterm birth: a population based study. *J Epidemiol Community Health.* 2006;60(4): 337–340
44. Spencer N, Devereux E, Wallace A, et al. Disabling conditions and registration for child abuse and neglect: a population-based study. *Pediatrics.* 2005;116(3):609–613
45. Rosen TS, Rosen J; American Academy of Pediatrics, Section on Home Health Care. Comprehensive home care program for the socially high-risk infant. In: McConnell MS, Imaizumi SO, eds. *Guidelines for Pediatric Home Health Care*. Elk Grove Village, IL: American Academy of Pediatrics; 2002:297–305
46. Leuthner SR, Boldt AM, Kirby RS. Where infants die: examination of place of death and hospice/home health care options in the state of Wisconsin. *J Palliat Med.* 2004;7(2):269–277
47. Zwerdling T, Hamann KC, Kon AA. Home pediatric compassionate extubation: bridging intensive and palliative care. *Am J Hosp Palliat Care.* 2006;23(3):224–228
48. Leuthner SR, Pierucci R. Experience with neonatal palliative care consultation at the Medical College of Wisconsin-Children's Hospital of Wisconsin. *J Palliat Med.* 2001;4(1): 39–47
49. American Academy of Pediatrics, Section on Ophthalmology; American Academy of Ophthalmology; American Association of Pediatric Ophthalmology and Strabismus. Screening examination of premature infants for retinopathy of prematurity [published correction appears in *Pediatrics*. 2006;118(3):1324]. *Pediatrics.* 2006;117(2):572–576
50. American Academy of Pediatrics, Task Force on Newborn and Infant Hearing Loss. Newborn and infant hearing loss: detection and intervention. *Pediatrics.* 1999;103(2):527–530
51. Joint Committee on Infant Hearing. Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. *Pediatrics.* 2000;106(4):798–817
52. Kaye CI; American Academy of Pediatrics, Committee on Genetics. Newborn screening facts sheet. *Pediatrics.* 2006;118(3): 934–963
53. American Academy of Pediatrics, Committee on Infectious Diseases and Committee on Fetus and Newborn. Policy statement: revised indications for the use of palivizumab and respiratory syncytial virus immune globulin intravenous for the prevention of respiratory syncytial virus infections. *Pediatrics.* 2003; 112(6 pt 1):1442–1446
54. Meissner HC, Long SS; American Academy of Pediatrics, Committee on Infectious Diseases and Committee on Fetus and Newborn. Technical report: revised indications for the use of palivizumab and respiratory syncytial virus immune globulin intravenous for the prevention of respiratory syncytial virus infections. *Pediatrics.* 2003;112(6 pt 1):1447–1452
55. Vohr BR, O'Shea M, Wright LL. Longitudinal multicenter follow-up of high-risk infants: why, who, when, and what to assess. *Semin Perinatol.* 2003;27(4):333–342
56. Vohr B, Wright LL, Hack M, Aylward G, Hirtz D. Follow-up care of high-risk infants. *Pediatrics.* 2004;114(5 suppl): 1377–1397
57. Hummel P, Cronin J. Home care of the high-risk infant. *Adv Neonatal Care.* 2004;4(6):354–364
58. Pearson SR, Boyce WT. The vulnerable child syndrome. *Pediatr Rev.* 2004;25(10):345–348
59. Saari TN; American Academy of Pediatrics, Committee on Infectious Diseases. Immunization of preterm and low birth weight infants. *Pediatrics.* 2003;112(1 pt 1):193–198
60. American Academy of Pediatrics, Committee on Injury and Poison Prevention and Committee on Fetus and Newborn. Safe transportation of premature and low birth weight infants. *Pediatrics.* 1996;97(5):758–760
61. American Academy of Pediatrics, Committee on Injury and Poison Prevention. Transporting children with special health care needs. *Pediatrics.* 1999;104(4 pt 1):988–992
62. Bull MJ, Sheese J. Update for the pediatrician on child passenger safety: five principles for safer travel. *Pediatrics.* 2000; 106(5):1113–1116

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

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Hospital Stay for Healthy Term Newborn Infants

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abstract

The hospital stay of the mother and her healthy term newborn infant should be long enough to allow identification of problems and to ensure that the mother is sufficiently recovered and prepared to care for herself and her newborn at home. The length of stay should be based on the unique characteristics of each mother-infant dyad, including the health of the mother, the health and stability of the newborn, the ability and confidence of the mother to care for herself and her newborn, the adequacy of support systems at home, and access to appropriate follow-up care in a medical home. Input from the mother and her obstetrical care provider should be considered before a decision to discharge a newborn is made, and all efforts should be made to keep a mother and her newborn together to ensure simultaneous discharge.

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PURPOSE

The purpose of this policy statement is to review issues related to length of stay and readmission of healthy term newborns and to identify specific criteria that should be met to ensure that discharge and subsequent follow-up are appropriate.

BACKGROUND

The hospital stay of the mother and her healthy term newborn infant (mother-infant dyad) should be long enough to allow identification of problems and to ensure that the mother is sufficiently recovered and prepared to care for herself and her newborn at home. Many neonatal cardiopulmonary problems related to the transition from the intrauterine to the extrauterine environment usually become apparent during the first 12 hours after birth.[1] Other neonatal problems, such as jaundice,[2,3] ductal-dependent cardiac lesions,[4,5] and gastrointestinal obstruction,[6] may require a longer period of observation by skilled health care professionals.[7] Likewise, significant maternal complications, such as endometritis, may not become apparent during the first day after delivery.

The average length of stay of the mother-infant dyad after delivery declined steadily from 1970 until the mid-1990s.[8] Early newborn

discharge was implemented in the 1990s, but in response to the ensuing debate on the care and safety of mothers and their infants, most states and the US Congress enacted legislation that ensured hospital stay for up to 48 hours for a vaginal delivery and up to 96 hours after birth by cesarean delivery. Several subsequent studies have reported that the postpartum length-of-stay legislation has led to an increase in postpartum length of stay, but the impact of this increase in length of stay on the rate of neonatal readmissions has been inconsistent.[8–11]

Risk of Readmission

Criteria for newborn discharge include physiologic stability, family preparedness and competence to provide newborn care at home, availability of social support, and access to the health care system and resources. An inadequate assessment by health care providers in any of these areas before discharge can place an infant at risk and may result in readmission. In several large epidemiologic studies, readmission rates were used to assess the adequacy of the newborn hospital length of stay. In these reports, readmissions after an early discharge varied from no increase to a significant increase.[8,12–15] However, the differences in the definition of early discharge, postdischarge follow-up and support, and the timing of readmissions make it difficult to compare the results. In some of these studies, the risk factors for readmission to identify infants who may benefit from either a longer hospital stay or close postdischarge follow-up also were evaluated. These studies identified jaundice, dehydration, and feeding difficulties as the most common reasons for readmission.[16,17] Other frequently reported risk factors for readmission were Asian race, primiparity, associated maternal morbidities, shorter gestation or lower birth weight, instrumented vaginal delivery, and small size for gestational age.[13,15–18] Close follow-up and better coordination of postdischarge care were important factors in decreasing the readmission rates.[13,17]

Readiness for Discharge

Readiness for discharge of a healthy term infant is traditionally determined by pediatric care providers after a review of the mother's and family members' ability to provide care to a newborn infant at home. However, perceptions about the degree of readiness at the time of discharge often differ among pediatric care providers, obstetrical care providers, and mothers.[18] Factors associated with perceived unreadiness for maternal or neonatal discharge, primarily as reported by mothers themselves, include first live birth, maternal history of chronic disease or illness after birth, in-hospital neonatal illness, intent to breastfeed, mothers with inadequate prenatal care and poor social support, and black non-Hispanic maternal race.[13,18] Although no specific clinical tool is currently available to evaluate mothers' or families' perception of readiness for discharge after delivery, the American Academy of Pediatrics Safe and Healthy Beginnings toolkit contains a discharge-readiness checklist that can aid clinicians with preparation of a newborn for discharge. This tool was tested by 22 clinical practice teams during the Safe and Healthy Beginnings improvement project and focuses on risk for severe hyperbilirubinemia, availability of breastfeeding support, and coordination of newborn care.[19] All efforts should be made to keep mothers and infants together to promote simultaneous discharge. To accomplish this, a pediatric care provider's decision to discharge a newborn should be made jointly with input from the mother, her obstetrical care provider, and other health care providers, such as nursing staff and social workers, who are involved in the care of the mother and her infant.

RECOMMENDATIONS

The length of stay of a healthy term newborn should be based on the unique characteristics of each mother-infant dyad, including the health of the mother, the health and stability of the infant, the ability and confidence of the mother to care for her infant, the adequacy of support systems at home, and access to appropriate follow-up care. Input from the mother and her obstetrical care provider and nursing staff should be considered before a decision to discharge a newborn is made, and all efforts should be made to keep a mother and her newborn together to encourage on-demand breastfeeding and to ensure simultaneous discharge. It is recommended that the following minimum criteria be met before discharge of a term newborn, defined as an infant born between 37-0/7 and 41-6/7 weeks of gestation[20] after an uncomplicated pregnancy, labor, and delivery.

1. Clinical course and physical examination reveal no abnormalities that require continued hospitalization.
2. The infant's vital signs are documented as being within normal ranges, with appropriate variations based on physiologic state, and stable for the 12 hours preceding discharge. These ranges include an axillary temperature of 36.5°C to 37.4°C (97.7–99.3°F, measured properly in an open crib with appropriate clothing),[21] a respiratory rate below 60 per minute[22] and no other signs of respiratory distress, and an awake heart rate of 100 to 190 beats per minute.[23] Heart rates as low as 70 beats per minute while sleeping quietly, without signs of circulatory compromise and responding appropriately to activity, also are acceptable. Sustained heart rates near or above the upper end of this range may require further evaluation.

3. The infant has urinated regularly and passed at least 1 stool spontaneously.
4. The infant has completed at least 2 successful feedings. If the infant is breastfeeding, a caregiver knowledgeable in breastfeeding, latch, swallowing, and infant satiety should observe an actual feeding and document successful performance of these tasks in the medical record.[24] If the infant is bottle-feeding, it is documented that the newborn is able to coordinate sucking, swallowing, and breathing while feeding.
5. There is no evidence of excessive bleeding at the circumcision site for at least 2 hours.
6. The clinical significance of jaundice, if present before discharge, has been determined, and appropriate management and/or follow-up plans have been instituted as recommended in American Academy of Pediatrics clinical practice guidelines for management of hyperbilirubinemia.[2]
7. The infant has been adequately evaluated and monitored for sepsis on the basis of maternal risk factors and in accordance with current guidelines for management of neonates with suspected or proven early-onset sepsis.[25]
8. Maternal and infant laboratory tests are available and have been reviewed, including the following:
   - maternal syphilis, hepatitis B surface antigen, and HIV status; and
   - umbilical cord or newborn blood type and direct Coombs test result, if clinically indicated.[2]
9. Initial hepatitis B vaccine has been administered as indicated by the infant's risk status and according to the current immunization schedule.[26]
10. If the mother has not previously been vaccinated, she should receive tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (Tdap) vaccine immediately after the infant is born. Other adolescents and adults who will have or anticipate having close contact with the infant should be encouraged to receive a single dose of Tdap if they have not previously received Tdap.[27] If a mother who delivers during the flu season has not been previously immunized, she also should receive an influenza vaccination.[28]
11. Newborn metabolic,[29] hearing,[30,31] and pulse oximetry[32–34] screenings have been completed per hospital protocol and state regulations. If screening metabolic tests were performed before 24 hours of milk feeding, a system for repeating the test during the follow-up visit must be in place in accordance with local or state policy.
12. The mother's knowledge, ability, and confidence to provide adequate care for her infant are documented by the fact that training and information has been received in the following areas:
    - the importance and benefits of breastfeeding for both mother and infant;
    - appropriate urination and stooling frequency for the infant;
    - umbilical cord, skin, and newborn genital care, as well as temperature assessment and measurement with a thermometer;
    - signs of illness and common infant problems, particularly jaundice;
    - infant safety, such as use of an appropriate car safety seat, supine positioning for sleeping, maintaining a smoke-free environment, and sleeping in proximity but not bed-sharing[35,36]; and
    - hand hygiene, especially as a way to reduce infection.
13. A car safety seat appropriate for the infant's maturity and medical condition that meets Federal Motor Vehicle Safety Standard 213 has been obtained and is available before hospital discharge, and the mother has demonstrated to trained hospital personnel appropriate infant positioning and use.
14. Family members or other support persons, including health care providers who are familiar with newborn care and are knowledgeable about lactation and the recognition of jaundice and dehydration, are available to the mother and infant after discharge.
15. A physician-directed source of continuing health care (medical home) for the mother and infant has been identified. Instructions to follow in the event of a complication or emergency have been provided. The mother should know how to reach the medical home and should have scheduled the infant's first visit, if possible, or know how to do so.
16. Family, environmental, and social risk factors have been assessed, and the mother and her other family members have been educated about safe home environment. When the following or other risk factors are present, discharge should be delayed until they are resolved or a plan to safeguard the newborn is in place. This plan may involve discussions with social services and/or state agencies, such as child protective services. These risk factors may include, but are not limited to the following:
    - untreated parental use of illicit substances or positive urine

toxicology results in the mother or newborn consistent with maternal abuse or misuse of drugs;

- history of child abuse or neglect by any anticipated care provider;
- mental illness in a parent or another person in the home;
- lack of social support, particularly for single, first-time mothers;
- no fixed home;
- history of domestic violence, particularly during this pregnancy;
- adolescent mother, particularly if other previously listed conditions apply; or
- barriers to adequate follow-up care for the newborn, such as lack of transportation to medical care services, lack of easy access to telephone communication, and non–English-speaking parents.

17. For newborns discharged before 48 hours after delivery, an appointment should be made for the infant to be examined by a health care practitioner within 48 hours of discharge.[10,12,16,37,38] If this cannot be ensured, discharge should be deferred until a mechanism for follow-up is identified. The follow-up visit can take place in a home, clinic, or hospital outpatient setting as long as the health care professional who examines the infant is competent in newborn assessment and the results of the follow-up visit are reported to the infant's primary care provider or his or her designee on the day of the visit. The purpose of the follow-up visit is to
    - promote establishment of a relationship with the medical home by verifying the plan for health care maintenance, including a method for obtaining emergency services, preventive care and immunizations, periodic evaluations and physical examinations, and necessary screenings;
    - weigh the infant and assess the infant's general health, hydration, and degree of jaundice, and identify any new problems;
    - review feeding patterns and technique, and encourage and support breastfeeding by observation of the adequacy of position, latch, and swallowing;
    - obtain historical evidence of adequate stool and urine patterns;
    - provide or make a referral for lactation support if the foregoing evaluations are not reassuring;
    - assess quality of mother-infant attachment and details of infant behavior;
    - reinforce maternal or family education in infant care, particularly regarding feeding and sleep position, avoidance of cosleeping, and appropriate use of car safety seats, which should be used only for travel and not for positioning in the home;
    - review results of outstanding laboratory tests, such as newborn metabolic screens, performed before discharge;
    - perform screenings in accordance with state regulations and other tests that are clinically indicated, such as serum bilirubin; and
    - assess for parental well-being with focus on screening for maternal postpartum depression.

CONCLUSIONS

The timing of discharge from the hospital should be the decision of the health care provider caring for the mother and her newborn. This decision should be made in consultation with the family and should not be based on arbitrary policies established by third-party payers. A shortened hospital stay (less than 48 hours after delivery) for healthy, term newborns can be accommodated but is not appropriate for every mother and newborn. If possible, institutions are encouraged to develop processes to prevent the necessity for early discharge of uninsured or underinsured newborn infants for purely financial reasons, however. Institutions should develop guidelines through their professional staff in collaboration with appropriate community agencies, including third-party payers, to establish hospital-stay programs for mothers and their healthy newborns. State and local public health agencies also should be involved in the oversight of existing hospital-stay programs for quality assurance and monitoring. Obstetrical care, newborn nursery care, and follow-up care should be considered independent services to be paid as separate packages and not as part of a global fee for maternity-newborn labor and delivery services. Adoption of standardized processes, such as predischarge checklists, may facilitate more uniform implementation of these recommendations across the full spectrum of health care settings where care for newborn infants is provided.

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REFERENCES

1. Desmond MM, Rudolph AJ, Phitaksphraiwan P. The transitional care nursery. A mechanism for preventive medicine in the newborn. *Pediatr Clin North Am*. 1966;13(3):651–668
2. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*. 2004;114(1): 297–316
3. Maisels MJ, Bhutani VK, Bogen D, Newman TB, Stark AR, Watchko JF. Hyperbilirubinemia in the newborn infant > or =35 weeks' gestation: an update with clarifications. *Pediatrics*. 2009;124(4):1193–1198
4. Gentile R, Stevenson G, Dooley T, Franklin D, Kawabori I, Pearlman A. Pulsed Doppler echocardiographic determination of time of ductal closure in normal newborn infants. *J Pediatr*. 1981;98(3):443–448
5. Lambert EC, Canent RV, Hohn AR. Congenital cardiac anomalies in the newborn. A review of conditions causing death or severe distress in the first month of life. *Pediatrics*. 1966;37(2): 343–351
6. Juang D, Snyder CL. Neonatal bowel obstruction. *Surg Clin North Am*. 2012; 92(3):685–711, ix–x
7. Jackson GL, Kennedy KA, Sendelbach DM, et al. Problem identification in apparently well neonates: implications for early discharge. *Clin Pediatr (Phila)*. 2000;39(10):581–590
8. Datar A, Sood N. Impact of postpartum hospital-stay legislation on newborn length of stay, readmission, and mortality in California. *Pediatrics*. 2006; 118(1):63–72
9. Madden JM, Soumerai SB, Lieu TA, Mandl KD, Zhang F, Ross-Degnan D; Health maintenance organization. Effects of a law against early postpartum discharge on newborn follow-up, adverse events, and HMO expenditures. *N Engl J Med*. 2002;347(25):2031–2038
10. Meara E, Kotagal UR, Atherton HD, Lieu TA. Impact of early newborn discharge legislation and early follow-up visits on infant outcomes in a state Medicaid population. *Pediatrics*. 2004;113(6): 1619–1627
11. Madden JM, Soumerai SB, Lieu TA, Mandl KD, Zhang F, Ross-Degnan D. Length-of-stay policies and ascertainment of postdischarge problems in newborns. *Pediatrics*. 2004;113(1 pt 1):42–49
12. Kotagal UR, Atherton HD, Eshett R, Schoettker PJ, Perlstein PH. Safety of early discharge for Medicaid newborns. *JAMA*. 1999;282(12):1150–1156
13. Watt S, Sword W, Krueger P. Longer postpartum hospitalization options—who stays, who leaves, what changes? *BMC Pregnancy Childbirth*. 2005;5:13
14. Grupp-Phelan J, Taylor JA, Liu LL, Davis RL. Early newborn hospital discharge and readmission for mild and severe jaundice. *Arch Pediatr Adolesc Med*. 1999;153(12):1283–1288
15. Paul IM, Lehman EB, Hollenbeak CS, Maisels MJ. Preventable newborn readmissions since passage of the Newborns' and Mothers' Health Protection Act. *Pediatrics*. 2006;118(6): 2349–2358
16. Escobar GJ, Greene JD, Hulac P, et al. Rehospitalisation after birth hospitalisation: patterns among infants of all gestations. *Arch Dis Child*. 2005; 90(2):125–131
17. Danielsen B, Castles AG, Damberg CL, Gould JB. Newborn discharge timing and readmissions: California, 1992-1995. *Pediatrics*. 2000;106(1 pt 1):31–39
18. Bernstein HH, Spino C, Finch S, et al. Decision-making for postpartum discharge of 4300 mothers and their healthy infants: the Life Around Newborn Discharge study. *Pediatrics*. 2007;120(2). Available at: www.pediatrics.org/cgi/content/full/120/2/e391
19. Safe and Healthy Beginnings. A resource toolkit for hospitals and physicians' offices. 2009. Available at: https://www.aap.org/en-us/professional-resources/practice-support/quality-improvement/Quality-Improvement-Innovation-Networks/Pages/Safe-and-Healthy-Beginnings-A-Resource-Toolkit-for-Hospitals-and-Physicians-Offices.aspx?aid=2577. Accessed March 3, 2014
20. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No 579: definition of term pregnancy. *Obstet Gynecol*. 2013;122(5):1139–1140
21. Mayfield SR, Bhatia J, Nakamura KT, Rios GR, Bell EF. Temperature measurement in term and preterm neonates. *J Pediatr*. 1984;104(2):271–275
22. Taylor WC, Watkins GM. Respiratory rate patterns in the newborn infant. *Can Med Assoc J*. 1960;83:1292–1295
23. Semizel E, Oztürk B, Bostan OM, Cil E, Ediz B. The effect of age and gender on the electrocardiogram in children. *Cardiol Young*. 2008;18(1):26–40
24. Hagan JF, Shaw JS, Duncan PM, eds. Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents. 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2008
25. Polin RA, Papile LA, Baley JE, et al; Committee on Fetus and Newborn. Management of neonates with suspected or proven early-onset bacterial sepsis. *Pediatrics*. 2012;129(5):1006–1015
26. Centers for Disease Control and Prevention. Recommended immunization schedule for persons aged 0 through 18 years: United States—2014. Available at: www.cdc.gov/vaccines/schedules/downloads/child/0-18yrs-schedule.pdf. Accessed March 10, 2014
27. Centers for Disease Control and Prevention (CDC). Updated recommendations for use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap) in pregnant women—Advisory Committee on Immunization Practices (ACIP), 2012. *MMWR Morb Mortal Wkly Rep*. 2013; 62(7):131–135
28. Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines. Recommendations of the Advisory Committee on Immunization Practices–United States, 2013-2014. *MMWR Recomm Rep*. 2013;62(RR-07): 1–43
29. American Academy of Pediatrics Newborn Screening Authoring

Committee. Newborn screening expands: recommendations for pediatricians and medical homes—implications for the system. *Pediatrics*. 2008;121(1):192–217

30. American Academy of Pediatrics, Joint Committee on Infant Hearing. Year 2007 position statement: principles and guidelines for early hearing detection and intervention programs. *Pediatrics*. 2007;120(4):898–921
31. Harlor AD Jr, Bower C; Committee on Practice and Ambulatory Medicine; Section on Otolaryngology-Head and Neck Surgery. Hearing assessment in infants and children: recommendations beyond neonatal screening. *Pediatrics*. 2009;124(4):1252–1263
32. Kemper AR, Mahle WT, Martin GR, et al. Strategies for implementing screening for critical congenital heart disease. *Pediatrics*. 2011;128(5). Available at: www.pediatrics.org/cgi/content/full/128/5/e1259
33. Mahle WT, Martin GR, Beekman RH III, Morrow WR; Section on Cardiology and Cardiac Surgery Executive Committee. Endorsement of Health and Human Services recommendation for pulse oximetry screening for critical congenital heart disease. *Pediatrics*. 2012;129(1):190–192
34. US Department of Health and Human Services. HHS Secretary adopts recommendation to add critical congenital heart disease to the Recommended Uniform Screening Panel. 2012. Available at: www.hrsa.gov/advisorycommittees/mchbadvisory/heritabledisorders/recommendations/correspondence/cyanoticheartsecre09212011.pdf. Accessed November 3, 2013
35. Durbin DR; Committee on Injury, Violence, and Poison Prevention. Child passenger safety. *Pediatrics*. 2011;127(4):788–793
36. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: expansion of recommendations for a safe infant sleeping environment. *Pediatrics*. 2011;128(5):1030–1039
37. Escobar GJ, Braveman PA, Ackerson L, et al. A randomized comparison of home visits and hospital-based group follow-up visits after early postpartum discharge. *Pediatrics*. 2001;108(3):719–727
38. Nelson VR. The effect of newborn early discharge follow-up program on pediatric urgent care utilization. *J Pediatr Health Care*. 1999;13(2):58–61

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Guidance for the Clinician in Rendering Pediatric Care

The American College of Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

CLINICAL REPORT

Immersion in Water During Labor and Delivery

abstract

FREE

Immersion in water has been suggested as a beneficial alternative for labor, delivery, or both and over the past decades has gained popularity in many parts of the world. Immersion in water during the first stage of labor may be associated with decreased pain or use of anesthesia and decreased duration of labor. However, there is no evidence that immersion in water during the first stage of labor otherwise improves perinatal outcomes, and it should not prevent or inhibit other elements of care. The safety and efficacy of immersion in water during the second stage of labor have not been established, and immersion in water during the second stage of labor has not been associated with maternal or fetal benefit. Given these facts and case reports of rare but serious adverse effects in the newborn, the practice of immersion in the second stage of labor (underwater delivery) should be considered an experimental procedure that only should be performed within the context of an appropriately designed clinical trial with informed consent. Facilities that plan to offer immersion in the first stage of labor need to establish rigorous protocols for candidate selection, maintenance and cleaning of tubs and immersion pools, infection control procedures, monitoring of mothers and fetuses at appropriate intervals while immersed, and immediately and safely moving women out of the tubs if maternal or fetal concerns develop. *Pediatrics* 2014;133:758–761

AMERICAN ACADEMY OF PEDIATRICS Committee on Fetus and Newborn and AMERICAN COLLEGE OF OBSTETRICIANS AND GYNECOLOGISTS Committee on Obstetric Practice

KEY WORDS
labor, delivery, water birth, immersion, perinatal care

ABBREVIATIONS
CI—confidence interval
RCT—randomized controlled trial
RR—risk ratio

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

INTRODUCTION

Immersion in water has been suggested as a beneficial alternative for labor, delivery, or both and over the past decades has gained popularity in many parts of world.[1–4] Approximately 1% of births in the United Kingdom include at least a period of immersion,[5] and a 2006 joint statement from the Royal College of Obstetricians and Gynaecologists and Royal College of Midwives supported immersion in water during labor for healthy women with uncomplicated pregnancies and stated that to achieve best practice with water birth, it is necessary for organizations to provide systems and structure to support this service.[6] The prevalence of this practice in the United States is unknown, because such data are not collected as part of

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vital statistics. A 2001 survey found that at least 143 US birthing centers offered immersion in water during labor, delivery, or both.[7] A 2005 commentary by the Committee on Fetus and Newborn of the American Academy of Pediatrics did not endorse underwater birth.[8] This clinical report reviews the literature concerning the reported risks and benefits of immersion in water during labor and delivery.

EVIDENCE REGARDING IMMERSION IN WATER DURING LABOR AND DELIVERY

Before examining available evidence concerning immersion during childbirth, it is important to recognize the limitations of studies and evidence in this area. Most published articles that recommend underwater births are retrospective reviews of a single center experience, observational studies using historical controls, or personal opinions and testimonials, often in publications that are not peer reviewed.[1–3,9–11] Also of importance, there are no basic science studies in animals or humans to confirm the physiologic mechanisms proposed to underlie the reported benefits of underwater births.

Other issues, in addition to the nature and design of studies, complicate the interpretation of the published findings, including the absence of a uniform definition of the exposure itself. Often, immersion is referred to as "underwater birth," but effects and outcomes may be different for immersion during the first stage and second stage of labor. This clinical report, accordingly, avoids the term underwater birth and makes an effort to distinguish data and outcomes related separately to immersion in the first stage and second stage of labor. Not all studies, however, distinguish when in the course of labor and delivery immersion was undertaken. Outcomes indicating safety or risk in association with immersion at 1 stage may not translate into equivalent outcomes at a different stage of labor; specifically, safety during labor may not translate into safety during delivery. In addition to this important limitation, immersion therapies have varied between studies in the duration of immersion, the depth of the bath or pool, the temperature of the water, and whether or not agitation (jets or whirlpool) was used. In considering the evaluation of outcomes, it is important to note that health care providers involved in providing or studying immersion therapy are not masked to either the treatment or outcomes, and especially in nonrandomized studies, outcomes may be influenced by differences in the environment attending a particular choice of delivery. Finally, most trials of immersion therapy are small, which limits their power to detect rare outcomes.

Randomized controlled trials (RCTs) would be ideal to address many of the aforementioned concerns. A 2009 Cochrane review identified 12 relevant and appropriately designed RCTs of immersion during labor, which involved 3243 women. Nine of these trials involved immersion during the first stage of labor alone (1 of 9 trials compared early versus later immersion during the first stage), 2 trials involved first stage and second stage of labor, and 1 trial involved comparing only the second stage of labor with the controls. Even among these RCTs, however, some of the aforementioned limitations remain, including concerns about power and how the absence of blinding might affect definition of outcomes. The systematic review also noted that most trials have small sample sizes and, thus, a high risk of bias. These factors limit comparison across trials and the reliability and validity of the trial findings.[5]

PROPOSED BENEFITS FROM IMMERSION DURING LABOR AND DELIVERY

There have been claims concerning the positive effects of immersion during labor.[12–14] Immersion is known to affect maternal cardiovascular physiology as hydrostatic pressure promotes increased venous return and mobilization of extravascular fluid and edema.[15,16] In part as a result of these effects, proponents of underwater immersion during labor and delivery argue that there are a variety of benefits to such treatment, including a decrease in perinatal pain, a greater sense of well-being and control, and a decreased rate of perineal trauma. Some advocates argue that immersion during labor and delivery decreases maternal stress and stress-associated hormone levels. It could also potentially benefit the newborn infant with a gentler transition from the in utero to ex utero environment.[1–7]

Individual retrospective analyses and case series argue in support of 1 or more of the benefits listed previously, but among RCTs studying immersion in the first stage of labor that were included in the 2009 Cochrane systematic review,[5] results were inconsistent. Although many individual RCTs reported no benefit, the combined data indicated that immersion during the first stage of labor was associated with decreased use of epidural, spinal, or paracervical analgesia among those allocated to water immersion compared with controls (478/1254 vs 529/1245; risk ratio [RR] 0.90; 95% confidence interval [CI], 0.82 to 0.99; 6 trials). There was a reduction in duration of the first stage of labor (mean difference −32.4 minutes; 95% CI, −58.7 to −6.13). However, considering each of these effects (particularly the latter), it is difficult to know how factors other than immersion, such as the structure of care (including health

care providers and timing and frequency of examinations) affected outcome. Furthermore, there were no differences in perineal trauma or tears (RR, 1.16; 95% CI, 0.99 to 1.35; 5 trials) or need for either assisted vaginal deliveries (RR, 0.86; 95% CI, 0.71 to 1.05; 7 trials) or cesarean delivery (RR, 1.21; 95% CI, 0.87 to 1.65; 8 trials) between those allocated to the immersion and control arms in the meta-analysis results.

Among the 2 trials that reported outcomes from immersion in the second stage of labor included in this systematic review,[5] the only difference in maternal outcomes from immersion during the second stage was an improvement in satisfaction among those allocated to immersion in 1 trial. None of the individual trials or the Cochrane systematic review[5] has reported any benefit to the newborn infant from maternal immersion during labor or delivery.

REPORTED COMPLICATIONS FROM IMMERSION DURING LABOR AND DELIVERY

Individual case reports and case series have noted complications for the mother and the neonate[17–25] that highlight potential risks from immersion during labor and delivery. Because the denominators are not uniformly reported, the exact incidence of complications is difficult to assess. Some of the reported concerns include higher risk of maternal and neonatal infections, particularly with ruptured membranes; difficulties in neonatal thermoregulation; umbilical cord avulsion and umbilical cord rupture while the newborn infant is lifted or maneuvered through and from the underwater pool at delivery, which leads to serious hemorrhage and shock; respiratory distress and hyponatremia that results from tub-water aspiration (drowning or near drowning); and seizures and perinatal asphyxia.[23]

Among this list of complications, given its potential seriousness, the possibility of a neonate aspirating water during birth while immersed has been the focus of understandable concern. Alerdice et al[26] summarized case reports of adverse neonatal outcomes, including drownings and near drownings. The case reports included immersion births in hospitals and at home. Subsequently, a study by Byard and Zuccollo reported 4 cases of severe respiratory distress in neonates after water birth, 1 of whom died of overwhelming sepsis from *Pseudomonas aeruginosa*.[19] Although it has been claimed that neonates delivered into the water do not breathe, gasp, or swallow water because of the protective "diving reflex," studies in experimental animals and a vast body of literature from meconium aspiration syndrome demonstrate that, in compromised fetuses and neonates, the diving reflex is overridden,[27,28] which leads potentially to gasping and aspiration of the surrounding fluid.

Morbidity and mortality, including respiratory complications, suggested in case series were not seen in the 2009 Cochrane synthesis of RCTs, which concluded that "there is no evidence of increased adverse effects to the fetus/neonate or woman from laboring in water or water birth."[5] This conclusion, however, should be tempered by several concerns, including the issue of the power of the sample size to identify rare but potentially serious outcomes. In this regard, in an RCT[29] excluded from the Cochrane analysis (because included labors all involved dystocia), 12% of neonates who were delivered in the immersion arm required admission to the NICU, as compared with none in the group delivered without immersion.

SUMMARY

Immersion in water during the first stage of labor may be appealing to some and may be associated with decreased pain or use of anesthesia and decreased duration of labor; however, there is no evidence that immersion during the first stage of labor otherwise improves perinatal outcomes. Immersion therapy during the first stage of labor should not prevent or inhibit other elements of care, including appropriate maternal and fetal monitoring.

In contrast, the safety and efficacy of immersion in water during the second stage of labor have not been established, and immersion in water during the second stage of labor has not been associated with maternal or fetal benefit. Given these facts and case reports of rare but serious adverse effects in the newborn, the practice of immersion in the second stage of labor (underwater delivery) should be considered an experimental procedure that only should be performed within the context of an appropriately designed clinical trial with informed consent.

Although not the focus of specific trials, facilities that plan to offer immersion in the first stage of labor need to establish rigorous protocols for candidate selection, maintenance and cleaning of tubs and immersion pools, infection control procedures, monitoring of mothers and fetuses at appropriate intervals while immersed, and protocols for moving women from tubs if urgent maternal or fetal concerns develop.

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*The views expressed in this document are not necessarily those of the Eunice Kennedy Shriver National Institute of Child Health and Human Development, the National Institutes of Health, or the Department of Health and Human Services.

REFERENCES

1. Geissbühler V, Eberhard J. Waterbirths: a comparative study. A prospective study on more than 2,000 waterbirths. *Fetal Diagn Ther*. 2000;15(5):291–300
2. Geissbuehler V, Stein S, Eberhard J. Waterbirths compared with landbirths: an observational study of nine years. *J Perinat Med*. 2004;32(4):308–314
3. Woodward J, Kelly SM. A pilot study for a randomised controlled trial of waterbirth versus land birth. *BJOG*. 2004;111(6):537–545
4. Chaichian S, Akhlaghi A, Rousta F, Safavi M. Experience of water birth delivery in Iran. *Arch Iran Med*. 2009;12(5):468–471
5. Cluett ER, Burns E. Immersion in water in labour and birth. *Cochrane Database Syst Rev*. 2009;(2):CD000111
6. Immersion in Water During Labour and Birth. RCOG/Royal College of Midwives Joint Statement No. 1. London, England: Royal College of Obstetricians and Gynaecologists, Royal College of Midwives; 2006. Available at: www.rcog.org.uk/womens-health/clinical-guidance/immersion-water-during-labour-and-birth. Accessed February 6, 2013
7. Mackey MM. Use of water in labor and birth. *Clin Obstet Gynecol*. 2001;44(4):733–749
8. Batton DG, Blackmon LR, Adamkin DH, et al; Committee on Fetus and Newborn, 2004–2005. Underwater births [commentary]. *Pediatrics*. 2005;115(5):1413–1414
9. Enning C. How to support the autonomy of motherbaby in second stage of waterbirth. *Midwifery Today Int Midwife*. 2011;(98):40–41
10. Maude RM, Foureur MJ. It's beyond water: stories of women's experience of using water for labour and birth. *Women Birth*. 2007;20(1):17–24
11. Moore M. How to make a portable waterbirth tub. *Midwifery Today Int Midwife*. 2002;(61):38–39
12. Edlich RF, Towler MA, Goitz RJ, et al. Bioengineering principles of hydrotherapy. *J Burn Care Rehabil*. 1987;8(6):580–584
13. Ginesi L, Niecierowicz R. Neuroendocrinology and birth 2: the role of oxytocin. *Br J Midwifery*. 1998;6(12):791–796
14. Garland D, Jones KC. Waterbirth: supporting practice with clinical audit. *MIDIRS Midwifery Dig*. 2000;10(3):333–336
15. Katz VL, Rozas L, Ryder R, Cefalo RC. Effect of daily immersion on the edema of pregnancy. *Am J Perinatol*. 1992;9(4):225–227
16. Katz VL, McMurray R, Berry MJ, Cefalo RC, Bowman C. Renal responses to immersion and exercise in pregnancy. *Am J Perinatol*. 1990;7(2):118–121
17. Bowden K, Kessler D, Pinette M, Wilson E. Underwater birth: missing the evidence or missing the point? [published correction appears in *Pediatrics*. 2004;113:433] *Pediatrics*. 2003;112(4):972–973
18. Pinette MG, Wax J, Wilson E. The risks of underwater birth. *Am J Obstet Gynecol*. 2004;190(5):1211–1215
19. Byard RW, Zuccollo JM. Forensic issues in cases of water birth fatalities. *Am J Forensic Med Pathol*. 2010;31(3):258–260
20. Eckert K, Turnbull D, MacLennan A. Immersion in water in the first stage of labor: a randomized controlled trial. *Birth*. 2001;28(2):84–93
21. Franzin L, Cabodi D, Scolfaro C, Gioannini P. Microbiological investigations on a nosocomial case of *Legionella pneumophila* pneumonia associated with water birth and review of neonatal cases. *Infez Med*. 2004;12(1):69–75
22. Gilbert R. Water birth—a near-drowning experience. *Pediatrics*. 2002;110(2 pt 1):409
23. Kassim Z, Sellars M, Greenough A. Underwater birth and neonatal respiratory distress. *BMJ*. 2005;330(7499):1071–1072
24. Mottola MF, Fitzgerald HM, Wilson NC, Taylor AW. Effect of water temperature on exercise-induced maternal hyperthermia on fetal development in rats. *Int J Sports Med*. 1993;14(5):248–251
25. Nguyen S, Kuschel C, Teele R, Spooner C. Water birth—a near-drowning experience. *Pediatrics*. 2002;110(2 pt 1):411–413
26. Alderdice F, Renfrew M, Marchant S, et al. Labour and birth in water in England and Wales. *BMJ*. 1995;310(6983):837
27. Johnson P. Birth under water—to breathe or not to breathe. *Br J Obstet Gynaecol*. 1996;103(3):202–208
28. Cammu H, Clasen K, Van Wettere L, Derde MP. "To bathe or not to bathe" during the first stage of labor. *Acta Obstet Gynecol Scand*. 1994;73(6):468–472
29. Cluett ER, Pickering RM, Getliffe K, St George Saunders NJ. Randomised controlled trial of labouring in water compared with standard of augmentation for management of dystocia in first stage of labour. *BMJ*. 2004;328(7435):314

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POLICY STATEMENT

Planned Home Birth

abstract

FREE

The American Academy of Pediatrics concurs with the recent statement of the American College of Obstetricians and Gynecologists affirming that hospitals and birthing centers are the safest settings for birth in the United States while respecting the right of women to make a medically informed decision about delivery. This statement is intended to help pediatricians provide supportive, informed counsel to women considering home birth while retaining their role as child advocates and to summarize the standards of care for newborn infants born at home, which are consistent with standards for infants born in a medical care facility. Regardless of the circumstances of his or her birth, including location, every newborn infant deserves health care that adheres to the standards highlighted in this statement, more completely described in other publications from the American Academy of Pediatrics, including *Guidelines for Perinatal Care*. The goal of providing high-quality care to all newborn infants can best be achieved through continuing efforts by all participating health care providers and institutions to develop and sustain communications and understanding on the basis of professional interaction and mutual respect throughout the health care system. *Pediatrics* 2013;131:1016–1020

COMMITTEE ON FETUS AND NEWBORN

KEY WORDS
birth, delivery, newborn infant, home birth, midwife, obstetrician, pediatrician

ABBREVIATIONS
ACOG—American College of Obstetricians and Gynecologists
AAP—American Academy of Pediatrics

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INTRODUCTION

Women and their families may desire a home birth for a variety of reasons, including hopes for a more family-friendly setting, increased control of the process, decreased obstetric intervention, and lower cost. Although the incidence of home birth remains below 1% of all births in the United States, the rate of home birth has increased during the past several years for white, non-Hispanic women.[1] However, a woman's choice to plan a home birth is not well supported in the United States. Obstacles are pervasive and systemic and include wide variation in state laws and regulations, lack of appropriately trained and willing providers, and lack of supporting systems to ensure the availability of specialty consultation and timely transport to a hospital. Geography also may adversely affect the safety of planned home birth, because travel times >20 minutes have been associated with increased risk of adverse neonatal outcomes, including mortality.[2] Whether for these reasons or others, planned home birth in the United States appears to be associated with a two- to threefold increase in neonatal mortality or an absolute risk increase of approximately 1 neonatal death per 1000 nonanomalous live births.[3–5] Evidence also suggests that infants born at home in the United States

have an increased incidence of low Apgar scores and neonatal seizures.[3,4] In contrast, a smaller study of all planned home births attended by midwives in British Columbia, Canada, from 2000 to 2004 revealed no increase in neonatal mortality over planned hospital births attended by either midwives or physicians.[6] Registered midwives in British Columbia are mandated to offer women the choice to deliver in a hospital or at home if they meet the eligibility criteria for home birth defined by the College of Midwifery of British Columbia (Table 1).

In a recent position statement, the Committee on Obstetric Practice of the American College of Obstetricians and Gynecologists (ACOG) stated, "although the Committee on Obstetric Practice believes that hospitals and birthing centers are the safest setting for birth, it respects the right of a woman to make a medically informed decision about delivery. Women inquiring about planned home birth should be informed of its risks and benefits based on recent evidence."[7] The statement reviewed appropriate candidates for home delivery and outlined the health care system components "critical to reducing perinatal mortality rates and achieving favorable home birth outcomes" (Table 1).

Pediatricians must be prepared to provide supportive, informed counsel to women considering home birth while retaining their role as child advocates in assessing whether the situation is appropriate to support a planned home birth (Table 1). In addition to apprising the expectant mother of the increase in neonatal mortality and other neonatal complications with planned home birth, the pediatrician should advise her that the American Academy of Pediatrics (AAP) and ACOG support provision of care only by midwives who are certified by the American Midwifery Certification Board and should make her aware that some women who plan to deliver at home will need transfer to a hospital before delivery because of unanticipated complications. This percentage varies widely among reports, from approximately 10% to 40%, with a higher transfer rate for primiparous women.[8,9] The mother should be encouraged to see successful transfer not as a failure of the home birth but rather as a success of the system.

Care of the newborn infant born at home is a particularly important topic, because infants born at home are cared for outside the safeguards of the systems-based protocols required of hospitals and birthing centers. This situation places a larger burden on individual health care providers to remember and carry out all components of assessment and care of the newborn infant. To assist providers, this policy statement addresses 2 specific areas: resuscitation and evaluation of the newborn infant immediately after birth and essential elements of care and follow-up for the healthy term newborn infant.

TABLE 1 Recommendations When Considering Planned Home Birth

Candidate for home delivery[a]
- Absence of preexisting maternal disease
- Absence of significant disease occurring during the pregnancy
- A singleton fetus estimated to be appropriate for gestational age
- A cephalic presentation
- A gestation of 37 to <41 completed weeks of pregnancy
- Labor that is spontaneous or induced as an outpatient
- A mother who has not been referred from another hospital

Systems needed to support planned home birth
- The availability of a certified nurse-midwife, certified midwife, or physician practicing within an integrated and regulated health system
- Attendance by at least 1 appropriately trained individual (see text) whose primary responsibility is the care of the newborn infant
- Ready access to consultation
- Assurance of safe and timely transport to a nearby hospital with a preexisting arrangement for such transfers

Data are from refs 6, 7, 10, 11, and 13.

[a] ACOG considers previous cesarean delivery to be an absolute contraindication to planned home birth.[7]

ASSESSMENT, RESUSCITATION, AND CARE OF THE NEWBORN INFANT IMMEDIATELY AFTER BIRTH

As recommended by the AAP and the American Heart Association, there should be at least 1 person present at every delivery whose primary responsibility is the care of the newborn infant.[10] Situations in which both the mother and the newborn infant simultaneously require urgent attention are infrequent but will nonetheless occur. Thus, each delivery should be attended by 2 individuals, at least 1 of whom has the appropriate training, skills, and equipment to perform a full resuscitation of the infant in accordance of the principles of the Neonatal Resuscitation Program.[10] To facilitate obtaining emergency assistance when needed, the operational integrity of the telephone or other communication system should be tested before the delivery (as should every other piece of medical equipment), and the weather should be monitored. In addition, a previous arrangement with a medical facility needs to be in place to ensure a safe and timely transport in the event of an emergency.

Care of the newborn infant immediately after delivery should adhere to standards of practice as described in *Guidelines for Perinatal Care*[11] and include provision of warmth, initiation of appropriate resuscitation measures,

and assignment of Apgar scores. Although skin-to-skin contact with mother is the most effective way to provide warmth, portable warming pads should be available in case a newborn infant requires resuscitation and cannot be placed on the mother's chest. A newborn infant who requires any resuscitation should be monitored frequently during the immediate postnatal period, and infants who receive extensive resuscitation (eg, positive-pressure ventilation for more than 30–60 seconds) should be transferred to a medical facility for close monitoring and evaluation. In addition, any infant who has respiratory distress, continued cyanosis, or other signs of illness should be immediately transferred to a medical facility.

CARE OF THE NEWBORN

Subsequent newborn care should adhere to the AAP standards as described in *Guidelines for Perinatal Care* as well as to the AAP statement regarding care of the well newborn infant.[11–13] Although a detailed review of these standards would be far too lengthy to include in this statement, a few practice points are worthy of specific mention:

- *Transitional care (first 4–8 hours)*: The infant should be kept warm and undergo a detailed physical examination that includes an assessment of gestational age and intrauterine growth status (weight, length, and head circumference), as well as a comprehensive risk assessment for neonatal conditions that require additional monitoring or intervention. Temperature, heart and respiratory rates, skin color, peripheral circulation, respiration, level of consciousness, tone, and activity should be monitored and recorded at least once every 30 minutes until the newborn's condition is considered normal and has remained stable for 2 hours. An infant who is thought to be <37 weeks' gestational age should be transferred to a medical facility for continuing observation for conditions associated with prematurity, including respiratory distress, poor feeding, hypoglycemia, and hyperbilirubinemia, as well as for a car safety seat study.
- *Monitoring for group B streptococcal disease*: As recommended by the Centers for Disease Control and Prevention and the AAP, all pregnant women should be screened for group B streptococcal colonization at 35 to 37 weeks of gestation.[14] Women who are colonized should receive ≥4 hours of intravenous penicillin, ampicillin, or cefazolin. If the mother has received this intrapartum treatment and both she and her newborn infant remain asymptomatic, they can remain at home if the infant can be observed frequently by an experienced and knowledgeable health care provider. If the mother shows signs of chorioamnionitis or if the infant does not appear completely well, the infant should be transferred rapidly to a medical facility for additional evaluation and treatment.[14]
- *Glucose screening*: Infants who have abnormal fetal growth (estimated to be small or large for gestational age) or whose mothers have diabetes should be delivered in a hospital or birthing center because of the increased risk of hypoglycemia and other neonatal complications. If, after delivery, an infant is discovered to be small or large for gestational age or has required resuscitation, he or she should be screened for hypoglycemia as outlined in the AAP statement.[15] If hypoglycemia is identified and persists after feeding (glucose <45 mg/dL), the infant should be transferred promptly to a medical facility for continuing evaluation and treatment.
- *Eye prophylaxis*: Every newborn infant should receive prophylaxis against gonococcal ophthalmia neonatorum.
- *Vitamin K*: Every newborn infant should receive a single parenteral dose of natural vitamin K_1 oxide (phytonadione [0.5–1 mg]) to prevent vitamin K–dependent hemorrhagic disease of the newborn. Oral administration of vitamin K has not been shown to be as efficacious as parenteral administration for the prevention of late hemorrhagic disease. This dose should be administered shortly after birth but may be delayed until after the first breastfeeding.
- *Hepatitis B vaccination*: Early hepatitis B immunization is recommended for all medically stable infants with a birth weight >2 kg.
- *Assessment of feeding*: Breastfeeding, including observation of position, latch, and milk transfer, should be evaluated by a trained caregiver. The mother should be encouraged to record the time and duration of each feeding, as well as urine and stool output, during the early days of breastfeeding.
- *Screening for hyperbilirubinemia*: Infants whose mothers are Rh negative should have cord blood sent for a Coombs direct antibody test; if the mother's blood type is O, the cord blood may be tested for the infant's blood type and direct antibody test, but it is not required provided that there is appropriate surveillance, risk assessment, and follow-up.[16] All newborn infants should be assessed for risk of hyperbilirubinemia and undergo bilirubin screening between 24 and 48 hours. The bilirubin value should be plotted on the

hour-specific nomogram to determine the risk of severe hyperbilirubinemia and the need for repeat determinations.[13]

- *Universal newborn screening*: Every newborn infant should undergo universal newborn screening in accordance with individual state mandates, with the first blood specimen ideally collected between 24 and 48 hours of age. (A list of conditions for which screening is performed in each state is maintained online by the National Newborn Screening and Genetic Resource Center, available at http://genes-r-us.uthscsa.edu/resources/consumer/statemap.htm.)
- *Hearing screening*: The newborn infant's initial caregiver should ensure that the hearing of any infant born outside the hospital setting is screened by 1 month of age, in accordance with AAP recommendations.
- *Provision of follow-up care*: Comprehensive documentation and communication with the follow-up provider are essential. Written records should describe prenatal care, delivery, and immediate postnatal course, clearly documenting which screenings and medications have been provided by the birth attendant, and which remain to be performed. All newborn infants should be evaluated by a health care professional who is knowledgeable and experienced in pediatrics within 24 hours of birth and subsequently within 48 hours of that first evaluation. The initial follow-up visit should include infant weight and physical examination, especially for jaundice and hydration. If the mother is breastfeeding, the visit should include evaluation of any maternal history of breast problems (eg, pain or engorgement), infant elimination patterns, and a formal observed evaluation of breastfeeding, including position, latch, and milk transfer. The results of maternal and neonatal laboratory tests should be reviewed; clinically indicated tests, such as serum bilirubin, should be performed; and screening tests should be completed in accordance with state regulations. Screening for congenital heart disease should be performed by using oxygen saturation testing as recommended by the AAP.[17]

CONCLUSIONS

The AAP concurs with the recent position statement of the ACOG, affirming that hospitals and birthing centers are the safest settings for birth in the United States, while respecting the right of women to make a medically informed decision about delivery.[7] In addition, the AAP in concert with the ACOG does not support the provision of care by lay midwives or other midwives who are not certified by the American Midwifery Certification Board.[7]

Regardless of the circumstances of his or her birth, including location, every newborn infant deserves health care that adheres to the standards highlighted in this statement and more completely described in other AAP publications.[11–16] The goal of providing high-quality care to all newborn infants can best be achieved through continuing efforts by all participating providers and institutions to develop and sustain communications and understanding on the basis of professional interaction and mutual respect throughout the health care system.

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REFERENCES

1. MacDorman MF, Mathews TJ, Declercq E. Home births in the United States, 1990– 2009. *NCHS Data Brief.* 2012;Jan(84):1–8
2. Ravelli AC, Jager KJ, de Groot MH, et al. Travel time from home to hospital and adverse perinatal outcomes in women at term in the Netherlands. *BJOG.* 2011;118(4):457–465
3. Malloy MH. Infant outcomes of certified nurse midwife attended home births: United States 2000 to 2004. *J Perinatol.* 2010;30(9):622–627
4. Chang JJ, Macones GA. Birth outcomes of planned home births in Missouri: a population-based study. *Am J Perinatol.* 2011;28(7):529–536
5. Wax JR, Lucas FL, Lamont M, Pinette MG, Cartin A, Blackstone J. Maternal and newborn

outcomes in planned home birth vs planned hospital births: a meta-analysis [published correction appears in *Am J Obstet Gynecol*. 2011;204(4):e7–e13]. *Am J Obstet Gynecol*. 2010;203(3):243.e1–243.e8

6. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician [published correction appears in *CMAJ*. 2009;181(9):617]. *CMAJ*. 2009;181(6–7):377–383
7. ACOG Committee on Obstetric Practice. ACOG Committee opinion no. 476: planned home birth [published correction appears in *Obstet Gynecol*. 2011;117(5):1232]. *Obstet Gynecol*. 2011;117(2 pt 1):425–428
8. Lindgren HE, Rådestad IJ, Hildingsson IM. Transfer in planned home births in Sweden—effects on the experience of birth: a nationwide population-based study. *Sex Reprod Healthc*. 2011;2(3):101–105
9. Symon A, Winter C, Inkster M, Donnan PT. Outcomes for births booked under an independent midwife and births in NHS maternity units: matched comparison study. *BMJ*. 2009;Jun 11(338):b2060
10. Kattwinkel J, Perlman JM, Aziz K, et al; American Heart Association. Neonatal resuscitation: 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Pediatrics*. 2010;126(5). Available at: www.pediatrics.org/cgi/content/full/126/5/e1400
11. American Academy of Pediatrics; American College of Obstetricians and Gynecologists. Care of the newborn. In: Riley LE, Stark AR, Kilpatrick SJ, Papile L-A, eds. *Guidelines for Perinatal Care*. 7th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2012:265–320
12. American Academy of Pediatrics Committee on Fetus and Newborn. Hospital stay for healthy term newborns. *Pediatrics*. 2010; 125(2):405–409
13. American Academy of Pediatrics; American College of Obstetricians and Gynecologists. Neonatal complications and management of high-risk infants. In: Riley LE, Stark AR, Kilpatrick SJ, Papile L-A, eds. *Guidelines for Perinatal Care*. 7th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2012:321–382
14. Baker CJ, Byington CL, Polin RA; Committee on Infectious Diseases; Committee on Fetus and Newborn. Policy statement—recommendations for the prevention of perinatal group B streptococcal (GBS) disease. *Pediatrics*. 2011;128(3):611–616
15. Adamkin DH; Committee on Fetus and Newborn. Postnatal glucose homeostasis in late-preterm and term infants. *Pediatrics*. 2011;127(3):575–579
16. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation [published correction appears in *Pediatrics*. 2004;114(4):1138]. *Pediatrics*. 2004;114(1):297–316
17. Kemper AR, Mahle WT, Martin GR, et al. Strategies for implementing screening for critical congenital heart disease. *Pediatrics*. 2011;128(5). Available at: www.pediatrics.org/cgi/content/full/128/5/e1259

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CLINICAL REPORT

Safe Transportation of Preterm and Low Birth Weight Infants at Hospital Discharge

Guidance for the Clinician in Rendering Pediatric Care

Marilyn J. Bull, MD, William A. Engle, MD, the Committee on Injury, Violence, and Poison Prevention and the Committee on Fetus and Newborn

ABSTRACT

Safe transportation of preterm and low birth weight infants requires special considerations. Both physiologic immaturity and low birth weight must be taken into account to properly position such infants. This clinical report provides guidelines for pediatricians and other caregivers who counsel parents of preterm and low birth weight infants about car safety seats. *Pediatrics* 2009;123:1424–1429

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Key Words
safe transportation, preterm, premature, low birth weight, car safety seats, car beds

Abbreviation
FMVSS—Federal Motor Vehicle Safety Standard

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INTRODUCTION

Improved survival rates and earlier discharge of preterm (<37 weeks' gestation at birth) and low birth weight (<2500 g at birth) infants have increased the number of small infants who are being transported in private vehicles. Car safety seats that are used correctly are 71% effective in preventing fatalities attributable to passenger car crashes in infants.[1] To ensure that preterm and low birth weight infants are transported safely, the proper selection and use of car safety seats or car beds are necessary.

Federal Motor Vehicle Safety Standard (FMVSS) 213, which establishes design and dynamic performance requirements for child-restraint systems, applies to children weighing up to 65 lb. However, the standard has no minimum weight limit and does not address the relative hypotonia and risk of airway obstruction in preterm or low birth weight infants. Most rear-facing car safety seats are designated by the manufacturer for use by infants weighing more than 4 or 5 lb, with some designated for use from birth regardless of weight.

Infant dummies as small as 3.3 lb have been shown to be satisfactorily restrained in standard rear-facing car safety seats during crash tests.[2,3] Test dummies, however, cannot replicate the airway and tone variables that occur in preterm infants, and there is no information on restraint of infants who weigh less than 3.3 lb (1.5 kg).

Rear-facing car safety seats provide the best protection in a frontal crash, because the forces are transferred from the back of the restraint to the infant's back, the strongest part of an infant's body. The restraint also supports the infant's head. Severe tensile forces on the neck in flexion are also prevented by use of rear-facing car safety seats.[4]

The long-term experience and documented protective value of car safety seats make them the preferred choice for travel for all infants who can maintain cardiorespiratory stability in the semireclined position.[4] A car bed that meets FMVSS 213 may be indicated for infants who manifest apnea, bradycardia, or low oxygen saturation when positioned semireclined in a car safety seat.[2,5] Of note, some preterm and term infants positioned in car beds and car safety seats seem to have similar rates of apnea, bradycardia, and oxygen desaturation.[6,7]

A car bed is designed to accommodate an infant in a fully reclined position and is oriented in the vehicle seat perpendicular to the direction of travel. An infant is secured in the car bed with an internal harness, and the car bed is secured to the vehicle with the vehicle's seat belt. Car beds, like car safety seats, have specific weight requirements designated by the manufacturer and, like car safety seats, should be used according to manufacturer recommendations.

The size of the infant, especially for those born preterm, is an important consideration when selecting a car safety seat or car bed.[2,8] Weight, length, neurologic maturation, and associated medical conditions (especially bronchopulmonary dysplasia) all influence the potential risk of respiratory compromise for infants in seating devices.[6,9]

Preterm infants are subject to an increased risk of oxygen desaturation, apnea, and/or bradycardia,[10] especially when placed in a semireclined position in car safety seats.[5,11–13] Furthermore, frequent cardiorespiratory events and

intermittent hypoxia may adversely affect later neurodevelopment, psychosocial behavior, and academic achievement.[14,15] In 1 study, mental development in preterm infants with 5 or more cardiorespiratory events during 210 hours or more of cardiorespiratory monitoring was associated with a lower mental development index on the Bayley Scales of Infant Development (95.8 vs 100.4; $P = .04$)[14]; physical developmental indices were not different (94.4 vs 91.7; $P = .37$). It is unclear whether the association of cardiorespiratory events and lower mental development reflects an underlying abnormality or a negative consequence of the events. It is rational, if practical, to attempt to reduce the frequency and severity of cardiorespiratory events experienced by preterm infants seated in car safety seats to minimize potential neurodevelopmental sequelae. Therefore, car safety seat monitoring in the infant's own car safety seat before discharge from the hospital should be considered for all infants less than 37 weeks' gestation at birth to determine if physiologic maturity and stable cardiorespiratory function are present, as recommended in the American Academy of Pediatrics publication *Guidelines for Perinatal Care*.[16] Because information is limited about the severity and frequency of adverse outcomes in preterm infants who experience cardiorespiratory events, including those events that occur while in car safety seats, additional research is needed.[17]

Many infants are discharged from the hospital with cardiac/apnea monitors, supplemental oxygen, and, occasionally, portable ventilators, suction machines, batteries, and other equipment. These objects are heavy and could cause injury if they were to hit the child or another vehicle occupant in the event of a sudden stop or crash. Although there is no commercially available securement system for portable medical equipment, restraint is recommended.[18]

No data are available to establish a specific age or neurodevelopmental status at which an infant with respiratory compromise who was discharged from the hospital in a car bed can safely transition to a semireclined car safety seat. Before discontinuing use of a car bed, the physician can consider arranging for a follow-up study to determine when the infant can travel semireclined without apnea, bradycardia, or oxygen desaturation. The time to perform the test may vary depending on the rate of growth and neurologic maturation of the infant and the infant's respiratory status and should be determined by the treating physician.

Car safety seats are used frequently for positioning infants for purposes other than travel. Potential detrimental effects of excessive use of infant seating devices, including exacerbation of gastroesophageal reflux and potentiation of plagiocephaly, have been documented.[19,20] Use of car safety seats for purposes other than travel also may increase the risk of adverse cardiorespiratory and other adverse medical events.

CLINICAL IMPLICATIONS

Several important considerations for transportation of preterm and low birth weight infants at risk for recurrent oxygen desaturation, apnea, or bradycardia include the following.

1. The increased frequency of oxygen desaturation and episodes of apnea or bradycardia while sitting in car safety seats suggests that preterm infants should have a period of observation in a car safety seat, preferably their own, before hospital discharge. This period of observation should be performed with the infant carefully positioned for optimal restraint and the car safety seat placed at an angle that is approved for use in the vehicle. A period of observation for a minimum of 90 to 120 minutes or the duration of travel, whichever is longer, is suggested.[5,6,11,21]
2. Hospital staff who are trained in positioning infants properly in the car safety seat and in detecting apnea, bradycardia, and oxygen desaturation should conduct the car safety seat observation.
3. Hospitals should develop protocols to include car safety seat observation before discharge for infants born at less than 37 weeks' gestation.[22] Some hospital protocols include car safety seat observations for infants at risk of obstructive apnea, bradycardia, or oxygen desaturation other than those born at less than 37 weeks' gestation. Examples include infants with hypotonia (eg, Down syndrome or congenital neuromuscular disorders), infants with micrognathia (Pierre Robin sequence), and infants who have undergone congenital heart surgery.[9]
4. Families should be taught by trained hospital staff how to position the infant properly in the car safety seat.
5. The duration of time the infant is seated in a car safety seat should be minimized. Parents should be advised that car safety seats should be used only for travel.
6. A conventional car safety seat that allows for proper positioning of the preterm infant should be selected if a semiupright position can be maintained safely by the infant. Better observation of the infant may be possible when the child is in a rear-facing car safety seat adjacent to an adult rather than in a car bed. In addition, the protection provided by a rear-facing car safety seat is better documented than the protection provided by car beds.[4]
7. If events documented on cardiorespiratory monitoring in a car safety seat are deemed significant by the treating physician or the hospital policy, interventions to reduce the frequency of desaturation and episodes of apnea and bradycardia are recommended (eg, use of car bed; supplemental oxygen; continued hospitalization or further medical assessment). If a car bed is considered, a similar period of cardiorespiratory monitoring while the infant is in the car bed should be performed before discharge.
8. Infants with documented oxygen desaturation, apnea, or bradycardia in a semiupright position should travel in a supine or prone position in an FMVSS 213–approved car bed after an observation period

that is free of such events as described in point 1 above. This may need to be revised as new evidence becomes available from future research. Specific information regarding currently available car beds can be obtained from several resources.[23]

9. Before transitioning from a car bed, a period of observation of an infant for apnea, bradycardia, and oxygen desaturation in the infant's own semireclined car safety seat should be considered. The study can be performed as a home oxypneumocardiogram, as an outpatient polysomnogram, or as an observed outpatient clinical evaluation performed similarly to that described in point 1 above.
10. Infants at risk of respiratory compromise in car safety seats may be at similar risk with use of other upright equipment, including infant swings, infant seats, backpacks, slings, and infant carriers. Consideration should also be given to limiting the use of these devices until the child's respiratory status in a semireclined position is stable.[24]
11. Infants for whom home cardiac and apnea monitors are prescribed should use this monitoring equipment during travel and have portable, self-contained power available for at least twice the duration of the expected transport time.
12. Commercially available securement systems for portable medical equipment such as monitors are not available; therefore, this equipment should be wedged on the floor or under the vehicle seat to minimize the risk of it becoming a dangerous projectile in the event of a crash or sudden stop.[2,8]

Proper positioning of preterm and low birth weight infants in car safety seats is important for minimizing the risk of respiratory compromise. Specific national guidance for selecting car safety seats and positioning preterm and low birth weight infants includes the following.

1. Infants should ride facing the rear as long as possible and to the highest weight and length allowed by the manufacturer of the seat for greatest protection.[25-27] By the time infants weigh 20 lb or reach the top length allowed by the manufacturer of the seat, they should ride facing the rear in infant seats or convertible car safety seats approved for rear-facing use at higher weights and lengths. Most convertible car safety seats are approved for rear-facing use up to 30 to 35 lb and 36 in. Parents of infants born preterm may benefit from specific counseling about this concept.
2. Infant-only car safety seats with 3-point or 5-point harness systems or convertible car safety seats with 5-point harness systems provide optimum comfort, fit, and positioning for the preterm or low birth weight infant. A small infant should not be placed in a car safety seat with a shield, abdominal pad, or arm rest because of potential breathing difficulty behind the shield or injury to an infant's face and neck during a sudden stop or crash.[2,21]
3. Car safety seats with the shortest distances from the crotch strap to the seat back should be selected to reduce the potential for the infant to slip forward feet-first under the harness (ie, "submarining"). Some car safety seats have crotch-to-seat back distances as short as 5.5 in, which may accommodate some preterm or low birth weight infants well. A small rolled diaper or blanket between the crotch strap and the infant may be added to reduce the risk of submarining (Fig 1) in smaller infants. A car safety seat with multiple harness-strap slots provides more choice and may be more suitable for small but rapidly growing infants. Ideally, car safety seats with harness straps that can be positioned at or below the shoulders should be selected.[21]
4. The infant should be properly positioned in the car safety seat, with buttocks and back flat against the back of the car safety seat. The harness must be snug, and the car safety seat's retainer clip should be positioned at the midpoint of the infant's chest, not on the abdomen or in front of the neck (Fig 1).
5. Some car safety seats come with head-support systems as standard equipment. Many head-support systems, however, are sold as aftermarket products and may decrease the safety provided by the seat and harness system, because they introduce slack into harness straps. Only products that come with the seat or are sold by the manufacturer for use with their specific seat should be used. Most very small infants require positioning support in addition to the head support that comes with the seat. Blanket rolls may be placed on both sides of the infant to provide lateral support for the head and trunk (Fig 1).
6. The rear-facing car safety seat should be reclined approximately 45° or as directed by the instructions

FIGURE 1
Car safety seat with a small cloth between crotch strap and infant, retainer clip positioned at the midpoint of the infant's chest, and blanket rolls on both sides of the infant.

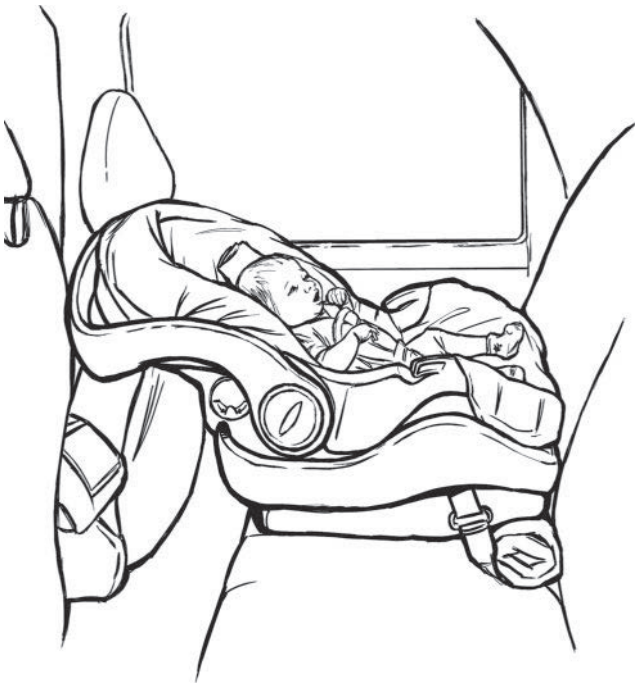

FIGURE 2
Seat with tightly rolled towel to recline seat halfway back at a 45° angle.

provided with the car safety seat. If the vehicle seat slopes and the seat is too upright, the infant's head may fall forward. A lightweight, noncompressible object, such as a tightly rolled blanket or pool "noodle," may be placed under the car safety seat to achieve the appropriate angle. Some car safety seats have built-in angle indicators and angle adjusters to assist with achieving the proper angle (Fig 2).

7. A rear-facing car safety seat should never be placed in the front passenger seat of any vehicle equipped with a passenger-side front air bag because of risk of death or serious injury from the impact of the air bag. In some vehicles without rear seating positions, the air bag can be deactivated when the front seat is used for a child passenger. The back seat is the safest place for all children to travel.[28,29]
8. Infants riding in the rear seat may be more difficult to observe, and whenever possible, parents should arrange for an adult to be seated in the rear seat adjacent to the infant. In the event of a monitor alarm, if a second caregiver is not available, the driver may need to come safely to a stop and assess the infant.
9. An infant should never be left unattended in a car safety seat inside or out of the car.

RESEARCH IMPLICATIONS

1. Studies are needed to gather more information on the severity and frequency of adverse outcomes in preterm infants who experience cardiorespiratory events, including those events that occur while in car safety seats.
2. Studies need to be conducted to determine the risk factors associated with cardiorespiratory events among preterm and low birth weight infants and criteria that indicate neurodevelopmental and physiologic maturity required for an infant to be positioned upright without respiratory compromise.
3. Studies should be designed to assess the correlation of car safety seat monitoring performed in the hospital, while stationary in the car, and while traveling.
4. Methods should be developed to better determine the relative protection provided by rear-facing car safety seats and car beds.
5. Design of car safety seats should be encouraged to specifically meet the positioning and transportation needs of preterm and low birth weight infants.
6. Methods should be developed to better secure heavy medical equipment, such as monitors and oxygen, in vehicles.
7. The efficacy of various protocols for car safety seat monitoring and car safety seats for different patient populations of at-risk infants needs to be determined.

SUMMARY

Proper selection and use of car safety seats or car beds are important for ensuring that preterm and low birth weight infants are transported as safely as possible.

The increased frequency of oxygen desaturation or episodes of apnea or bradycardia experienced by preterm and low birth weight infants positioned semireclined in car safety seats may expose them to increased risk of cardiorespiratory events and adverse neurodevelopmental outcomes.

It is suggested that preterm infants should have a period of observation of 90 to 120 minutes (or longer, if time for travel home will exceed this amount) in a car safety seat before hospital discharge. Educating parents about the proper positioning of preterm and low birth weight infants in car safety seats is important for minimizing the risk of respiratory compromise. Providing observation and avoiding extended periods in car safety seats for vulnerable infants and using car seats only for travel should also minimize risk of adverse events.

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REFERENCES

1. National Highway Traffic Administration. *Research Note: Revised Estimates of Child Restraint Effectiveness.* Washington, DC: US Department of Transportation, National Center for Statistics and Analysis; 1996. Available at: www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.e649cd1b2b018c7d8eca01046108a0c/. Accessed March 10, 2008
2. Bull M, Weber K, Stroup K. Automotive restraint systems for premature infants. *J Pediatr.* 1988;112(3):385–388
3. National Center for Safe Transportation of Children With Special Needs. Child Restraint System Test Results. Available at: www.preventinjury.org/uploads/researchinfo/ResearchInfo_11.pdf. Accessed April 9, 2009
4. Weber K. Crash protection for child passengers: a review of best practice. *UMTRI Res Rev.* 2000;31(3):1–28
5. Willett LD, Leuschen MP, Nelson LS, Nelson RM Jr. Risk of hypoventilation in premature infants in car seats. *J Pediatr.* 1986;109(2):245–248
6. Salhab WA, Khattak A, Tyson JE, et al. Car seat or car bed for very low birth weight infants at discharge home. *J Pediatr.* 2007;150(3):224–228
7. Kinane TB, Murphy J, Bass JL, Corwin MJ. Comparison of respiratory physiologic features when infants are placed in car safety seats or car beds [published correction appears in *Pediatrics*. 2006;118(5):2270]. *Pediatrics.* 2006;118(2):522–527
8. Bull MJ, Stroup KB. Premature infants in car seats. *Pediatrics.* 1985;75(2):336–339
9. Simsic JM, Masterson K, Kogon BE, Kirshbom PM, Kanter K. Pre-hospital discharge car safety seat testing in infants after congenital heart surgery. *Pediatr Cardiol.* 2008;29(1):142–145
10. Ramanathan R, Corwin MJ, Hunt CE, et al. Cardiorespiratory events recorded on home monitors: comparison of healthy infants with those at increased risk for SIDS. *JAMA.* 2001;285(17):2199–2207
11. Willett LD, Leuschen MP, Nelson LS, Nelson RM Jr. Ventilatory changes in convalescent infants positioned in car seats. *J Pediatr.* 1989;115(3):451–455
12. Merchant JR, Worwa C, Porter S, Coleman JM, deRegnier RA. Respiratory instability of term and near-term healthy newborn infants in car safety seats. *Pediatrics.* 2001;108(3):647–652
13. Bass JL, Mehta KA, Camara J. Monitoring premature infants in car seats: implementing the American Academy of Pediatrics policy in a community hospital. *Pediatrics.* 1993;91(6):1137–1141
14. Hunt CE, Corwin MJ, Baird T, et al. Cardiorespiratory events detected by home memory monitoring and one-year neurodevelopmental outcome. *J Pediatr.* 2004;145(4):465–471
15. Bass JL, Corwin M, Gozal D, et al. The effect of chronic or intermittent hypoxia on cognition in childhood: a review of the evidence. *Pediatrics.* 2004;114(3):805–816
16. American Academy of Pediatrics; American College of Obstetricians and Gynecologists. Neonatal complications. In: *Guidelines for Perinatal Care.* 6th ed. Washington DC: American College of Obstetricians and Gynecologists; 2007:251–301
17. Côté A, Bairam A, Deschenes M, Hatzakis G. Sudden infant deaths in sitting devices. *Arch Dis Child.* 2008;93(5):384–389
18. American Academy of Pediatrics, Committee on Injury and Poison Prevention. Transporting children with special health care needs. *Pediatrics.* 1999;104(4 pt 1):988–992
19. Callahan CW. Increased gastroesophageal reflux in infants: can history provide an explanation? *Acta Paediatr.* 1998;87(12):1219–1223
20. Orenstein SR, Whittington PF, Orenstein DM. The infant seat as treatment for gastroesophageal reflux. *N Engl J Med.* 1983;309(13):760–763
21. National Highway Traffic Safety Administration. National Standardized Child Passenger Safety Training Program. Available at: www.safekids.org/certification/index.html. Accessed March 12, 2008
22. American Academy of Pediatrics, Committee on Injury and Poison Prevention. Safe transportation of newborns at hospital discharge. *Pediatrics.* 1999;104(4 pt 1):986–987
23. National Center for Safe Transportation of Children With Special Needs. Special Needs Transportation: Restraints. Available at: www.preventinjury.org/SNTrestraints.asp. Accessed March 12, 2008
24. Stening W, Nitsch P, Wassmer G, Roth B. Cardiorespiratory stability of premature and term infants carried in infant slings. *Pediatrics.* 2002;110(5):879–883
25. American Academy of Pediatrics, Committee on Injury and Poison Prevention. Selecting and using the most appropriate car safety seats for growing children: guidelines for counseling parents. *Pediatrics.* 2002;109(3):550–553

26. Henary B, Sherwood C, Crandall J, et al. Car safety seats for children: rear facing for best protection. *Inj Prev.* 2007;13(6): 398–402
27. National Highway Traffic Safety Administration. Child Passenger Safety: A Parent's Primer. Available at: www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/4StepsFlyer.pdf. Accessed April 9, 2009
28. Braver ER, Whitifield R, Ferguson SA. Seating positions and children's risk of dying in motor vehicle crashes. *Inj Prev.* 1998;4(3):181–187
29. Durbin D, Chen I, Smith R, Elliott M, Winston F. Effects of seating position and appropriate restraint use on the risk of injury to children in motor vehicle crashes. *Pediatrics.* 2005;115(3). Available at: www.pediatrics.org/cgi/content/full/115/3/e305

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

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Umbilical Cord Care in the Newborn Infant

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Postpartum infections remain a leading cause of neonatal morbidity and mortality worldwide. A high percentage of these infections may stem from bacterial colonization of the umbilicus, because cord care practices vary in reflection of cultural traditions within communities and disparities in health care practices globally. After birth, the devitalized umbilical cord often proves to be an ideal substrate for bacterial growth and also provides direct access to the bloodstream of the neonate. Bacterial colonization of the cord not infrequently leads to omphalitis and associated thrombophlebitis, cellulitis, or necrotizing fasciitis. Various topical substances continue to be used for cord care around the world to mitigate the risk of serious infection. More recently, particularly in high-resource countries, the treatment paradigm has shifted toward dry umbilical cord care. This clinical report reviews the evidence underlying recommendations for care of the umbilical cord in different clinical settings.

INTRODUCTION

Despite significant global progress in recent decades,[1] bacterial infections (sepsis, meningitis, and pneumonia) continue to account for approximately 700 000 neonatal deaths each year, or nearly one-quarter of the 3 million neonatal deaths that occur worldwide.[1,2] Although the magnitude of its contribution to these deaths remains uncertain, the umbilical cord may be a common portal of entry for invasive pathogenic bacteria,[3] with or without clinical signs of omphalitis. Neonatal mortality associated with bacterial contamination of the umbilical stump may therefore rank among the greatest public health opportunities of the 21st century.

Common risk factors for the development of neonatal omphalitis include unplanned home birth or septic delivery, low birth weight, prolonged rupture of membranes, umbilical catheterization, and chorioamnionitis.[4,5] In countries with limited resources, the risk of omphalitis may be 6 times greater for infants delivered at home than for hospital births.[6] Multiple studies have delineated the susceptibility of the umbilical

abstract

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cord to bacterial colonization. The method of caring for the umbilical cord after birth affects both bacterial colonization and time to cord separation.[7–10] The devitalized umbilical cord provides an ideal medium for bacterial growth. Sources of potentially pathogenic bacteria that colonize the umbilical cord include the mother's birth canal and various local bacterial sources at the site of delivery, most prominently the nonsterile hands of any person assisting with the delivery.[11] *Staphylococcus aureus* remains the most frequently reported organism.[5–7,12] Other common pathogens include group A and group B *Streptococci* and Gram-negative bacilli including *Escherichia coli*, *Klebsiella* species, and *Pseudomonas* species. Rarely, anaerobic and polymicrobial infections also may occur. In addition to omphalitis, tetanus in neonates can result from umbilical cord colonization, particularly in countries with limited resources. This infection results from contamination of the umbilical separation site by *Clostridium tetani* acquired from a nonsterile device used to separate the umbilical cord during the peripartum period or from application of unhygienic substances to the cord stump.

Multiple complications can occur from bacterial colonization and infection of the umbilical cord because of its direct access to the bloodstream. These complications include the development of intraabdominal abscesses, periumbilical cellulitis, thrombophlebitis in the portal and/or umbilical veins, peritonitis, and bowel ischemia.[13–16] Neonatal omphalitis may present at 4 grades of severity: (1) funisitis/umbilical discharge (an unhealthy-appearing cord with purulent, malodorous discharge), (2) omphalitis with abdominal wall cellulitis (periumbilical erythema and tenderness in addition to an unhealthy-appearing cord with discharge), (3) omphalitis with systemic signs of infection, and (4) omphalitis with necrotizing fasciitis (umbilical necrosis with periumbilical ecchymosis, crepitus, bullae, and evidence of involvement of superficial and deep fascia; frequently associated with signs and symptoms of overwhelming sepsis and shock).[6]

The incidence of omphalitis reported in different communities varies greatly, depending on prenatal and perinatal practices, cultural variations in cord care, and delivery venue (home versus hospital). Reliable current data on rates in untreated infants are surprisingly scant. In high-resource countries, neonatal omphalitis now is rare, with an estimated incidence of approximately 1 per 1000 infants managed with dry cord care (eg, a total of 3 cases among 3518 infants described in 2 reports from Canada[17,18]). In low-income communities, omphalitis occurs in up to 8% of infants born in hospitals and in as many as 22% of infants born at home, in whom omphalitis is moderate to severe in 17% and associated with sepsis in 2%.[19] Depending on how omphalitis is defined, case-fatality rates as high as 13% have been reported.[4] The development of necrotizing fasciitis, with predictable complications from septic shock, is associated with much higher case-mortality rates.[5] These disparate observations in different settings have resulted in divergent recommendations for cord care by the World Health Organization (WHO), which advocates dry cord care for infants born in a hospital or in settings of low neonatal mortality and application of chlorhexidine solution or gel for infants born at home or in settings of high neonatal mortality.[20]

EVIDENCE-BASED PRACTICE

Best practices for antisepsis of the umbilical cord continue to remain somewhat controversial and variable, even in high-resource countries with relatively aseptic conditions at the time of delivery. In resource-limited countries, in accordance with cultural traditions, unhygienic substances continue to be applied to the umbilicus, creating a milieu ideal for the development neonatal omphalitis. To achieve the goal of preventing omphalitis worldwide, deliveries must be clean and umbilical cord care must be hygienic. The cord should be cut with a sterile blade or scissors, preferably using sterile gloves, to prevent bacterial contamination leading to omphalitis or neonatal tetanus. As discussed later, dry cord care without the application of topical substances is preferable under most circumstances in high-resource countries and for in-hospital births elsewhere; the application of topical chlorhexidine is recommended for infants born outside the hospital setting in communities with high neonatal mortality rates.[20]

Methods of umbilical cord care have been the subject of 4 recent meta-analyses,[21–24] including 2 Cochrane reviews.[23,24] Although the scope and methodologies of these reviews differed, all 4 stratified results according to the study setting, distinguishing results reported from communities with high proportions of births at home and high neonatal mortality rates from those obtained in hospitals and settings with low neonatal mortality rates. These analyses concluded that 3 studies (including >44 000 subjects) in community settings in South Asia with a high neonatal mortality rate[3,25,26] support the effectiveness of application of 4% chlorhexidine solution or gel to the umbilical cord stump within 24 hours after birth, which results in a significant reduction in both omphalitis (relative risk [RR]: 0.48; 95% confidence interval [CI]: 0.40–0.57) and neonatal mortality

(RR: 0.81; 95% CI: 0.71–0.92) compared with dry cord care.[24] No other cord-management strategies have been evaluated systematically in such settings, but the application of traditional materials (eg, ash, herbal or other vegetal poultices, and human milk) may provide a source of contamination with pathogenic bacteria, including *C tetani*.[27] In contrast, the meta-analyses found little evidence of benefit from topical treatments for infants born in hospitals.[22–24] The meta-analyses used different criteria for inclusion of trials and compared a variety of treatments versus dry cord care or versus one another. Only a single trial[28] reported mortality data, which did not differ between topical chlorhexidine and dry care (RR: 0.11; 95% CI: 0.01–2.04). However, the low mortality rate and the small contribution made by bacterial infection[29] in these settings provide only a small opportunity for a reduction in mortality rates. In 5 such trials[30–33] analyzed by Karumbi et al,[22] no treatment was found to significantly reduce omphalitis and sepsis when compared against one another, although the sample sizes were small and the evidence was deemed of low quality.[22] The Cochrane review by Imdad et al,[23] which compared a variety of pairs of topical agents, reached similar conclusions. The most recent meta-analysis, by Sinha et al,[24] considered 2 studies[28,34] comparing chlorhexidine with dry cord care. In the first of these, 140 infants admitted to the NICU at a hospital in north India were randomly assigned to receive cord treatment with chlorhexidine solution or dry cord care.[28] Enrollment criteria included gestational age >32 weeks and birth weight >1500 g, but the provided demographic data suggest that the infants were predominantly late-preterm, and they experienced high rates of complications of prematurity (including asphyxia, respiratory distress, mechanical ventilation, and necrotizing enterocolitis). No cases of umbilical sepsis were reported in either group, but culture-proven sepsis was more common in the dry cord care group than in the chlorhexidine group (15 of 70 vs 2 of 70; $P = .002$). These observations cannot be generalized to all healthy infants born in a hospital. The second enrolled 669 subjects, who were randomly assigned to receive treatment with chlorhexidine powder or dry cord care.[34] Cord-related adverse events (erosion, irritation, lesion, omphalitis, erythema, umbilical granuloma, purulence, bleeding, discharge, or weeping of the navel) were more common in the dry cord care group (29% vs 16%; $P = .001$), but there were no differences in serious adverse events (2.1% in both groups) or in the incidence of omphalitis (2.1% vs 0.6%; $P = .1$). Although the meta-analysis reported a significant difference in the pooled risk of omphalitis (RR: 0.48; 95% CI: 0.28–0.84), combining culture-proven sepsis cases[28] with omphalitis cases[34] is not appropriate. This analysis provides only very weak, or perhaps no, evidence for a benefit of chlorhexidine treatment.

Since 1998, the WHO has advocated the use of dry umbilical cord care in high-resource settings.[35] Dry cord care includes keeping the cord clean and leaving it exposed to air or loosely covered by a clean cloth. If it becomes soiled, the remnant of the cord is cleaned with soap and sterile water. In situations in which hygienic conditions are poor and/or infection rates are high, the WHO recommends chlorhexidine.[16]

There is some uncertainty as to the effect of chlorhexidine on mortality when applied to the umbilical cords of newborn infants in the hospital setting, but there is moderate evidence for its effects on infection prevention.[24] Although the application of chlorhexidine is regarded as safe,[35] trace levels of the compound have been detected in the blood of infants after umbilical cord cleaning.[36,37] In addition, contact dermatitis has been reported in up to 15% of very low birth weight infants after placement of a 0.5% chlorhexidine impregnated dressing over a central venous catheter.[38] The data on the safety of chlorhexidine application are incomplete, and the amount of exposure to chlorhexidine that can be considered safe is not known.[24] In addition to the incremental increase in the cost of using chlorhexidine, the practice of reducing bacterial colonization may have the unintended consequences of selecting more virulent bacterial strains without demonstrable benefits.[24] Because the incidence of omphalitis is very low in high-resource countries and the severity is mild, the preponderance of evidence favors dry cord care.

PROMOTING NONPATHOGENIC COLONIZATION OF THE UMBILICAL CORD

Promoting colonization of the umbilical cord by nonpathogenic bacteria may prevent the development of neonatal omphalitis. By allowing neonates to "room-in" with their mothers, one can create an environment conducive for colonization from less pathogenic bacteria acquired from the mother's flora.[39] This type of colonization helps to reduce colonization and infection from potentially pathogenic organisms that are ubiquitous in the hospital environment. Over time, attempts to decrease bacterial colonization with topical antimicrobial agents may actually select for resistant and more pathogenic organisms[35] (level of evidence: III).

IMPLICATIONS FOR CLINICAL PRACTICE

1. Application of select antimicrobial agents to the umbilical cord may be beneficial for infants born at home in resource-limited

countries where the risks of omphalitis and associated sequelae are high.

2. Application of select antimicrobial agents to the umbilical cord does not provide clear benefit in the hospital setting or in high-resource countries, where reducing bacterial colonization may have the unintended consequence of selecting more virulent bacterial strains. In high-resource countries, there has been a shift away from the use of topical antimicrobial agents in umbilical cord care for this reason.
3. For deliveries outside of birthing centers or hospital settings and in resource-limited populations (eg, Native American communities), the application of prophylactic topical antimicrobial agents to the umbilical cord remains appropriate.
4. At the time of discharge, parental education regarding the signs and symptoms of omphalitis might decrease significant morbidities and even associated mortalities.
5. Of paramount importance is the need for all primary care providers to be diligent in reporting infections associated with umbilical cord care. The development of a local reporting system regarding the occurrence of omphalitis and/or its morbidities to the health care providers at the site of delivery will create more robust data, allowing for improvement in treatment paradigms in the future.

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ABBREVIATIONS

CI: confidence interval
RR: relative risk
WHO: World Health Organization

REFERENCES

1. Lawn JE, Blencowe H, Oza S, et al; Lancet Every Newborn Study Group. Every Newborn: progress, priorities, and potential beyond survival. *Lancet*. 2014;384(9938):189–205
2. Liu L, Johnson HL, Cousens S, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379(9832):2151–2161
3. Mullany LC, Darmstadt GL, Khatry SK, et al. Topical applications of chlorhexidine to the umbilical cord for prevention of omphalitis and neonatal mortality in southern Nepal: a community-based, cluster-randomised trial. *Lancet*. 2006;367(9514):910–918
4. Güvenç H, Aygün AD, Yaşar F, Soylu F, Güvenç M, Kocabay K. Omphalitis in term and preterm appropriate for gestational age and small for gestational age infants. *J Trop Pediatr*. 1997;43(6):368–372
5. Mason WH, Andrews R, Ross LA, Wright HT Jr. Omphalitis in the newborn infant. *Pediatr Infect Dis J*. 1989;8(8):521–525
6. Sawardekar KP. Changing spectrum of neonatal omphalitis. *Pediatr Infect Dis J*. 2004;23(1):22–26
7. Verber IG, Pagan FS. What cord care—if any? *Arch Dis Child*. 1993;68(5 spec no):594–596
8. Ronchera-Oms C, Hernández C, Jiménez NV. Antiseptic cord care reduces bacterial colonization but delays cord detachment. *Arch Dis Child Fetal Neonatal Ed*. 1994;71(1):F70
9. Novack AH, Mueller B, Ochs H. Umbilical cord separation in the normal newborn. *Am J Dis Child*. 1988;142(2):220–223
10. Arad I, Eyal F, Fainmesser P. Umbilical care and cord separation. *Arch Dis Child*. 1981;56(11):887–888
11. Mullany LC, Darmstadt GL, Katz J, et al. Risk factors for umbilical cord infection among newborns of southern Nepal. *Am J Epidemiol*. 2007;165(2):203–211
12. Airede AI. Pathogens in neonatalomphalitis. *J Trop Pediatr*. 1992;38(3):129–131
13. Forshall I. Septic umbilical arteritis. *Arch Dis Child*. 1957;32(161):25–30
14. Lally KP, Atkinson JB, Woolley MM, Mahour GH. Necrotizing fasciitis: a serious sequela of omphalitis in the newborn. *Ann Surg*. 1984;199(1):101–103
15. Monu JU, Okolo AA. Neonatal necrotizing fasciitis—a complication of poor cord hygiene: report of three cases. *Ann Trop Paediatr*. 1990;10(3):299–303
16. Samuel M, Freeman NV, Vaishnav A, Sajwany MJ, Nayar MP. Necrotizing fasciitis: a serious complication of omphalitis in neonates. *J Pediatr Surg*. 1994;29(11):1414–1416
17. Dore S, Buchan D, Coulas S, et al. Alcohol versus natural drying for newborn cord care. *J Obstet Gynecol Neonatal Nurs*. 1998;27(6):621–627
18. Janssen PA, Selwood BL, Dobson SR, Peacock D, Thiessen PN. To dye or not to dye: a randomized, clinical trial of a triple dye/alcohol regime versus dry cord care. *Pediatrics*. 2003;111(1):15–20
19. Mir F, Tikmani SS, Shakoor S, et al. Incidence and etiology of omphalitis

in Pakistan: a community-based cohort study. *J Infect Dev Ctries*. 2011;5(12):828–833

20. World Health Organization. *WHO Recommendations on Postnatal Care of the Mother and Newborn*. Geneva, Switzerland: WHO Press; 2014
21. Imdad A, Mullany LC, Baqui AH, et al. The effect of umbilical cord cleansing with chlorhexidine on omphalitis and neonatal mortality in community settings in developing countries: a meta-analysis. *BMC Public Health*. 2013;13(suppl 3):S3–S15
22. Karumbi J, Mulaku M, Aluvaala J, English M, Opiyo N. Topical umbilical cord care for prevention of infection and neonatal mortality. *Pediatr Infect Dis J*. 2013;32(1):78–83
23. Imdad A, Bautista RM, Senen KA, Uy ME, Mantaring JB III, Bhutta ZA. Umbilical cord antiseptics for preventing sepsis and death among newborns. *Cochrane Database Syst Rev*. 2013;5:CD008635
24. Sinha A, Sazawal S, Pradhan A, Ramji S, Opiyo N. Chlorhexidine skin or cord care for prevention of mortality and infections in neonates. *Cochrane Database Syst Rev*. 2015;3:CD007835
25. Arifeen SE, Mullany LC, Shah R, et al. The effect of cord cleansing with chlorhexidine on neonatal mortality in rural Bangladesh: a community-based, cluster-randomised trial. *Lancet*. 2012;379(9820):1022–1028
26. Soofi S, Cousens S, Imdad A, Bhutto N, Ali N, Bhutta ZA. Topical application of chlorhexidine to neonatal umbilical cords for prevention of omphalitis and neonatal mortality in a rural district of Pakistan: a community-based, cluster-randomised trial. *Lancet*. 2012;379(9820):1029–1036
27. Mrisho M, Schellenberg JA, Mushi AK, et al. Understanding home-based neonatal care practice in rural southern Tanzania. *Trans R Soc Trop Med Hyg*. 2008;102(7):669–678
28. Gathwala G, Sharma D, Bhakhri B. Effect of topical application of chlorhexidine for umbilical cord care in comparison with conventional dry cord care on the risk of neonatal sepsis: a randomized controlled trial. *J Trop Pediatr*. 2013;59(3):209–213
29. Centers for Disease Control and Prevention. QuickStats: leading causes of neonatal and postneonatal deaths—United States, 2002. *MMWR*. 2005;54(38):966
30. Ahmadpour-Kacho M, Zahedpasha Y, Hajian K, Javadi G, Talebian H. The effect of topical application of human milk, ethyl alcohol 96%, and silver sulfadiazine on umbilical cord separation time in newborn infants. *Arch Iran Med*. 2006;9(1):33–38
31. Erenel AS, Vural G, Efe SY, Ozkan S, Ozgen S, Erenoğlu R. Comparison of olive oil and dry-clean keeping methods in umbilical cord care as microbiological. *Matern Child Health J*. 2010;14(6):999–1004
32. Hsu WC, Yeh LC, Chuang MY, Lo WT, Cheng SN, Huang CF. Umbilical separation time delayed by alcohol application. *Ann Trop Paediatr*. 2010;30(3):219–223
33. Pezzati M, Rossi S, Tronchin M, Dani C, Filippi L, Rubaltelli FF. Umbilical cord care in premature infants: the effect of two different cord-care regimens (salicylic sugar powder vs chlorhexidine) on cord separation time and other outcomes. *Pediatrics*. 2003;112(4):e275
34. Kapellen TM, Gebauer CM, Brosteanu O, Labitzke B, Vogtmann C, Kiess W. Higher rate of cord-related adverse events in neonates with dry umbilical cord care compared to chlorhexidine powder: results of a randomized controlled study to compare efficacy and safety of chlorhexidine powder versus dry care in umbilical cord care of the newborn. *Neonatology*. 2009;96(1):13–18
35. World Health Organization. *Care of the Umbilical Cord: A Review of the Evidence*. Geneva, Switzerland: World Health Organization; 1998
36. Aggett PJ, Cooper LV, Ellis SH, McAinsh J. Percutaneous absorption of chlorhexidine in neonatal cord care. *Arch Dis Child*. 1981;56(11):878–880
37. Johnsson J, Seeberg S, Kjellmer I. Blood concentrations of chlorhexidine in neonates undergoing routine cord care with 4% chlorhexidine gluconate solution. *Acta Paediatr Scand*. 1987;76(4):675–676
38. Garland JS, Alex CP, Mueller CD, et al. A randomized trial comparing povidone-iodine to a chlorhexidine gluconate-impregnated dressing for prevention of central venous catheter infections in neonates. *Pediatrics*. 2001;107(6):1431–1436
39. Pezzati M, Biagioli EC, Martelli E, Gambi B, Biagiotti R, Rubaltelli FF. Umbilical cord care: the effect of eight different cord-care regimens on cord separation time and other outcomes. *Biol Neonate*. 2002;81(1):38–44

SECTION 2

Newborn Screening