RESEARCH ARTICLE

Evaluating Nursery Phototherapy Use and Discharge Practices After the Creation of a Weekend Newborn Clinic

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Neonatal jaundice has been reported for centuries and remains one of the most common newborn concerns, with nearly two-thirds of infants having jaundice in the first week of life.[1] Although most cases of jaundice are nonthreatening, many infants require treatment with phototherapy. Incidences of significantly high levels still remain, placing infants at risk for kernicterus, a rare but often preventable cause of permanent neurologic impairment. Bilirubin levels peak at 3 to 5 days of life, but with early infant discharges and barriers to establishing consistent follow-up care, physicians are challenged to determine which babies will go on to have pathologic jaundice requiring further intervention.[2]

The American Academy of Pediatrics (AAP) addressed this issue of newborn jaundice in 2004 and updated its stance in 2009, with a clinical practice guideline that recommends all well newborns receive a screening bilirubin level before discharge, with results interpreted using a specific risk nomogram (Fig 1).[2,3] On the basis of this algorithm, newborns who have bilirubin levels falling within the high-risk or high/intermediate-risk zones but do not require phototherapy may be discharged. These infants, however, should have a follow-up evaluation within 24 or 48 hours, based on the specific risk zone. This recommendation may be altered depending on the presence of associated risk factors (Fig 2). The guideline further states that if appropriate follow-up cannot be arranged for such babies, for example, because of lack of outpatient clinic hours on weekends and holidays, the discharges should be delayed until their risk factors have diminished.

Maricopa Medical Center in Phoenix, Arizona, is a large, safety-net hospital in an urban setting. There are ~3000 live births per year at the institution, and newborns generally follow up at 1 of 12 satellite primary care centers around the city. None of these clinics have office hours or laboratory accessibility over the weekends or holidays. The term nursery currently practices universal bilirubin screening before discharge. Our pediatricians noted that specifically on weekends, when encountering infants with elevated bilirubin levels not meeting phototherapy criteria, they had a management dilemma. Without available follow-up appointments, the options for management included drawing serial bilirubin levels to calculate a rate of rise, keeping infants with borderline-high bilirubin levels in the hospital for a recheck the next day, preventatively starting infants on phototherapy, or discharging these infants with follow-up in the pediatric emergency department. These options were not ideal because they led to unnecessary blood draws and potentially unnecessary procedures for infants, separation of mother and infant, interruption of bonding and breastfeeding, and parental anxiety. Furthermore, in cases using the emergency department, there exists a sizable infection exposure risk for the newborn and an inappropriate use of resources.[4]

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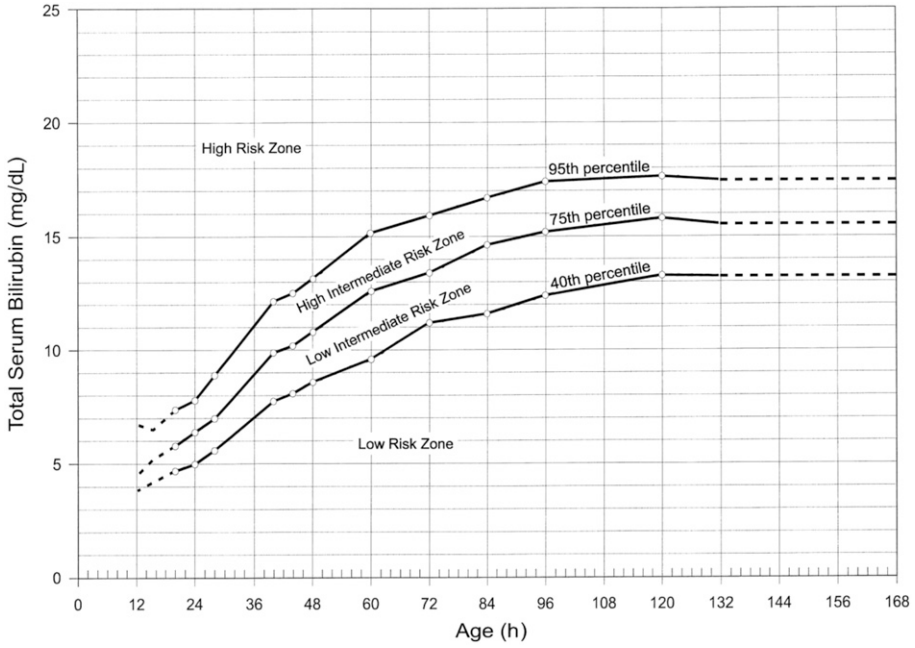

FIGURE 1 Risk designation of term and near-term well newborns based on hour-specific serum bilirubin values; used to interpret discharge bilirubin levels to predict babies at risk for levels that rise above the 95th percentile. (Reproduced with permission from the AAP and Bhutani VK, Johnson L, Sivieri EM. Predictive ability of a predischarge hour-specific serum bilirubin for subsequent significant hyperbilirubinemia in healthy term and near-term newborns. *Pediatrics*. 1999;103[1]:6–14)

A multidisciplinary committee from Maricopa Medical Center established a Weekend Newborn Clinic to ensure that no infants are discharged without appropriate follow-up and that none are unnecessarily kept in the hospital because of a lack of timely follow-up. The main goals of this study were to measure the impact of the Weekend Newborn Clinic. The primary outcome was to determine whether the ability to refer infants to the clinic led to fewer infants with borderline bilirubin levels started on phototherapy. Secondary outcomes to measure effectiveness of the clinic included (1) reduced hospital length of stay for newborns discharged over a weekend and (2) less separation of mothers and infants at the time of discharge. A supplementary goal was to describe the demographics of patients referred to the Weekend Newborn Clinic including their bilirubin levels, risk factors for jaundice, feeding practices, and dispositions from the clinic.

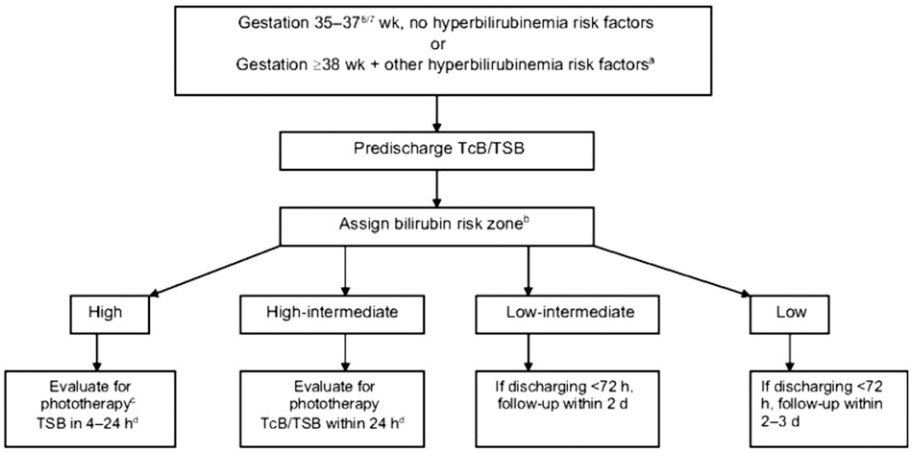

FIGURE 2 Example of an algorithm recommending timing for follow-up of newborns based on their predischarge bilirubin levels, gestation, and related risk factors. See full reference for algorithm variations. (Reproduced with permission from the AAP and Maisels MJ, Bhutani VK, Bogen D, et al. Hyperbilirubinemia in the newborn infant ≥35 weeks' gestation: an update with clarifications. *Pediatrics*. 2009;124[4]: 1193–1198)

METHODS

This was a retrospective comparative study, with historical controls, to determine the impact the Weekend Newborn Clinic had on length of stay, phototherapy use, and discrepancy of discharge dates between mothers and their infants. The study sample groups identified were newborns born at Maricopa Medical Center and discharged on a Friday, Saturday, or Sunday in the 12 months before and after the opening of the Weekend Newborn Clinic. Of note, Sunday was included to capture infants who may have been unnecessarily kept on Saturday night before the clinic opening due to a lack of weekend follow-up or those discharged over a holiday weekend with no Monday office hours.

Exclusion criteria included newborns in the NICU, those with nursery stays >4 days, and all newborns with the medical diagnoses of chorioamnionitis, suspected sepsis, newborn sepsis, neonatal withdrawal, and hypoglycemia, based on *International Classification of Diseases, Ninth Revision, Clinical* Modification, billing codes. These criteria were chosen specifically to exclude newborns with a prolonged hospital stay because they would most likely have elevated jaundice levels rechecked during the hospitalization rather than at an outpatient visit. In addition, we excluded patients with complex or nonroutine newborn care because the bilirubin risk stratification curve is designed for "well newborns," and these sicker infants often undergo a more intensive level of observation and management.

After applying exclusion criteria, the resulting sample of 1199 patient charts before the clinic opened, and 1343 patient charts after the clinic opened, were first retrospectively reviewed for length of stay. Charts of infants coded for newborn jaundice were then analyzed for major risk factors including prematurity and blood type incompatibility and to determine whether phototherapy was initiated for bilirubin levels >1.0 mg/dL below the standard threshold for treatment based on accepted guidelines from the AAP (Fig 3). This level of 1.0 mg/dL was chosen on the basis of general practices in our nursery in which, despite existing guidelines for precise levels to initiate phototherapy, these are not always followed as an absolute rule. Often, a level approaching but not reaching phototherapy level, combined with other minor medical and social risk factors, may contribute to the decision to start phototherapy. Charts for infants undergoing phototherapy were further analyzed to determine whether there was a discrepancy in the discharge dates between mothers and their infants undergoing phototherapy. An independent groups *t* test and Fisher's exact test were used to compare the results from the 2 data sets.

The supplementary goal of describing the characteristics of patients referred to the Weekend Newborn Clinic at the Maricopa Medical Center was accomplished through a retrospective chart of referrals from May 2009 through May 2014. Variables recorded included (1) discharge bilirubin risk zone (high-risk, high/intermediate risk, or low/intermediate/low-risk), based on a widely accepted bilirubin nomogram endorsed in the AAP Clinical Practice Guidelines for Hyperbilirubinemia (Fig 1); (2) the presence of major risk factors for jaundice (ABO incompatibility and gestational age <38 weeks); and (3) the discharge plan for the infants after their clinic visit (discharged from the hospital, admitted for phototherapy, seen in the Weekend Newborn Clinic the following day, or never arrived for appointment). Infants with any attempted breastfeeds in the nursery were also measured.

Approval for the protocol was obtained from the Maricopa Integrated Health System Institutional Review Board before initiation of the study.

RESULTS

In the first 5 years since the Weekend Newborn Clinic opened, 704 newborns have been evaluated on a Saturday, Sunday, or holiday. Table 1 reflects the characteristics of the infants referred to the clinic, including their discharge bilirubin level risk

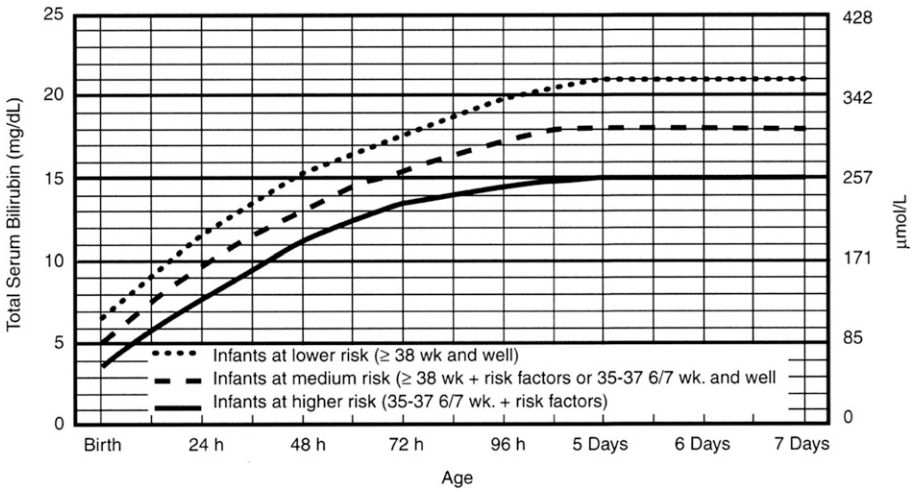

FIGURE 3 Guidelines for initiating phototherapy. (Reproduced with permission from the AAP Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*. 2004;114[1]: 297–316)

zone and those with ≥1 risk factors for jaundice. Of these referrals, 10% were for infants who had received phototherapy in the nursery or as a readmission to the inpatient unit.

When assessing disposition from the Weekend Newborn Clinic, we found that 92% of infants who were referred to the clinic were seen for their scheduled visit. Of these babies seen, 3.8% were admitted to the hospital for phototherapy, 5% were seen the following day in the Weekend Newborn Clinic, and 93% were transitioned back to their primary care provider for follow-up. Approximately 87% of infants seen at the clinic had attempted breastfeeding in the hospital, which is noteworthy because the practitioners offered lactation support to the mothers as part of the visit.

The comparative study evaluating the impact of the Weekend Newborn Clinic found that there was no significant difference in the number of infants receiving phototherapy over a weekend before and after the clinic opened. Before the clinic opened, 56 of 292 (19.2%) infants with the diagnosis of newborn jaundice received phototherapy. Of these, 76.8% had phototherapy started at levels that did not meet the determined phototherapy threshold. After the clinic opened, 52 of 298 (17.4%) infants with the diagnosis of neonatal jaundice received phototherapy. Of these, only 46.2% had phototherapy started below threshold. The reduction in number of infants started on phototherapy below standard threshold after the clinic opened was statistically significant ($P = .001$; Table 2). This is equivalent to a risk ratio of 0.601. The Weekend Newborn Clinic produced an absolute risk reduction of 30.6%, which is equivalent to a number needed to treat of 3.27 (Table 3).

Incidentally, compared with the preclinic data set of infants started on phototherapy, the postclinic data set included a higher percentage of infants born preterm (9% vs 25%) and those with high-risk discharge bilirubin levels (50% vs 77%). There was no significant difference in the number of infants who were Coombs positive. These variables were already taken into consideration when determining if phototherapy was warranted and therefore did not affect the statistical analysis.

The length of stay comparison of newborns discharged over a weekend before and after the clinic opened was 2.033 days versus 2.009 days, respectively, and was not significant ($P = .370$ according to an independent groups t test). There was also no significant difference between the numbers of infants discharged after their mothers.

DISCUSSION

Establishing follow-up for newborns in a high-risk population is paramount for providing high-quality medical care. The importance of close follow-up was reflected in the AAP Policy Statement from 2010, *Hospital Stay for Healthy Term Newborns*, remarking that "readiness for discharge" is not based solely on the clinical attributes of the newborn but also on having an identified medical home for ongoing care.[5] It is recognized in the statement that there may exist substantial barriers to obtaining this follow-up. Several studies evaluated local hospital and pediatric practice conformity with these AAP Guidelines for close-follow-up and the barriers for consistent compliance. Profit et al cited difficulties providing care during off hours and weekends and inadequate access to laboratory services as a contributing factor.[6] Salem-Schatz et al conducted focus groups, and 1 physician commented on "Friday Rules": infants who are discharged on a Friday are subject to different practice styles because they may not be seen until the following week.[7] The latter article lists "add weekend clinic hours to follow up newborns discharged on Thursday and Friday" among other strategies to address this problem. These similar observations motivated our hospital to establish the Weekend Newborn Clinic and further study its benefits.

This clinic opened in 2009 and is located within the main hospital. It is staffed by pediatric and neonatal nurse practitioners who are already employed by the health care system and simultaneously provide coverage in the term nursery and NICU. The pediatric hospitalist covering the inpatient unit is available for consultation. Referrals are based on discharge bilirubin risk zone level and additional risk factors for jaundice. Infants who received phototherapy in the nursery or on the inpatient floor may also be seen.

The Weekend Newborn Clinic appointments are in the afternoon after provider rounds. At the visit, infants are weighed, examined, and have bilirubin levels checked by transcutaneous meter or by serum. The providers are skilled at providing lactation support and addressing other concerns. Infants are then discharged from the hospital, seen in the clinic the following day, or admitted for phototherapy. All infants have a primary care provider established before their nursery discharge and are instructed to proceed with routine newborn follow-up after the weekend visit.

The analysis of the referral pattern to the Weekend Newborn Clinic demonstrated that most infants seen within 24 to 48 hours after discharge were those in the high-risk and high/intermediate-risk zones (77%), many with ≥1 major risk factor for jaundice. In addition, the large majority of the infants (93%) were sent home with their parents after their jaundice check, which is the preferred disposition for otherwise well newborns. These findings substantiate the goal of the clinic, which is to serve as a location for follow-up of well infants with

TABLE 1 Characteristics of the Infants Referred to the Weekend Newborn Clinic

Discharge Bilirubin Level Risk Zone	Infants in Each Risk Zone ($N = 704$)		Infants in Each Risk Zone With ≥1 Risk Factor for Jaundice[a]	
	Count	Percentage	Count	Percentage
High risk	82	12	28	34
High/intermediate risk	458	65	96	21
Low and low/intermediate risk	164	23	77	47

[a] Including Coombs positive and gestational age <38 wk.

TABLE 2 Effect of the Weekend Newborn Clinic on Various Outcomes

	Infants discharged on a Friday, Saturday, or Sunday	Infants Diagnosed With Jaundice	Infants Started on Phototherapy	Infants With Phototherapy Initiated >1.0 mg/dL Below Standard Threshold	Infants' Hospital Length of Stay (d)	Infants on phototherapy Discharged After Their Mothers
Before clinic opened	1199	292 (24.4%)	56 (19.2%)	43 (76.8%)	2.033	22 (51.1%)
After clinic opened	1343	298 (22.2%)	52 (17.4%)	24 (46.2%)	2.009	13 (54.2%)

Reduction in phototherapy initiated on infants with jaundice below standard threshold after opening the clinic was significant ($P = .001$). No significant decrease in length of stay or in separation of infants and mothers at discharge was noted.

elevated screening bilirubin in the nursery who otherwise meet criteria to go home.

There were a small percentage of infants referred to the Weekend Newborn Clinic that may not have seemed medically indicated, specifically infants with screening bilirubin levels in the low-risk zone. Pediatricians, however, often make follow-up decisions on a constellation of features that may not be measurable, rather than on a single factor. For example, reasons for many of these low-risk referrals included "lactation support" in addition to jaundice follow-up.

In evaluating all outcomes of the study, the most striking result was the impact the Weekend Newborn Clinic had on phototherapy practices. In the 12 months before opening the clinic, 76.8% of the infants requiring phototherapy were started below standard threshold. In addition to typical jaundice risk factors, our physicians frequently documented other reasons for initiating phototherapy, including those similarly cited in the literature: steep rate-of-rise in bilirubin levels, slow initiation of breastfeeding, and weight loss.[2] The Weekend Newborn Clinic addressed many of these concerns, including providing a familiar place for follow-up, closely assessing the infants' weight and feeding patterns, and offering lactation support. This led to a statistically significant reduction in initiation of phototherapy below standard threshold after the clinic was opened, and a finding that only 3.27 patients needed to be treated to avoid 1 case of unwarranted phototherapy. It further strengthens the study knowing this occurred with a population of infants in the postclinic data set with more risk factors, namely, prematurity and discharge bilirubin levels in the high-risk zone.

We expected to see a decrease in the length of stay in infants discharged on a weekend before and after the opening of the Weekend Newborn Clinic. There was, however, no significant reduction. The reasons for discharge, therefore, cannot be explained simply by jaundice or phototherapy guidelines. Discharge practices may be influenced by individual pediatric and obstetric clinicians' styles, postpartum maternal complications, socioeconomics, ethnicity, and hospital policy.[8] There was also no significant change in the number of infants who were separated from their mothers at discharge after this clinic opened.

One added benefit of the clinic was related to breastfeeding. The Joint United Nations Children's Fund/World Health Organization initiative, "Ten Steps to Successful Breastfeeding," endorses that establishing lactation support for the mother and infant, once they leave the hospital, is vital for the continuation of recommended breastfeeding practices.[9] One of the most challenging times for breastfeeding mothers is immediately after discharge, when they may have concerns about milk supply, experience breast pain, or feel overwhelmed due to a lack of support.[10] The Weekend Newborn Clinic serves as a bridge over the weekend to assist mothers with lactation immediately, rather than waiting 2 to 3 days to see their primary care provider.

There were several limitations to this study. The postintervention charts reviewed were from the 12 months immediately after the opening of the clinic. There may not yet have been a consistent referral pattern because of some provider's reluctance and a problematic scheduling process, perhaps leading to a continuation of some phototherapy practices that existed before the clinic opened. Because of the many factors in combination often used to determine if a infant requires phototherapy, rather than relying on an absolute bilirubin value, a margin of 1.0 mg/dL for each bilirubin level was applied when determining if phototherapy was initiated "below threshold"; however, this margin is variable among practitioners. We felt the study could have benefitted from a financial analysis, specifically looking at institutional cost savings from decreased phototherapy use; however, the information we obtained was not an accurate reflection of total hospital charges and therefore not useful for inclusion. Finally, it is necessary to address the viable option of home phototherapy blankets for lower-risk jaundiced infants and its impact on discharge practices. In an informal survey,

TABLE 3 Measures of Effect Size for Impact of the Weekend Newborn Clinic on Phototherapy Initiated on Infants Below Threshold

Measure	Point Estimate	95% Confidence Limits	
		Lower	Upper
Risk ratio	0.601	0.433	0.834
Relative risk reduction, %	39.8	16.6	56.7
Absolute risk reduction, %	30.6	13.1	48.1
Number needed to treat	3.27	2.08	7.63

our practitioners rarely or never sent infants home with phototherapy blankets, citing reasons such as concern for compliance in our socially high-risk patient population, difficulties with arranging a phototherapy blanket over the weekend, and lack of knowledge regarding insurance coverage for such equipment. Further exploration of this option with nursery case managers and providers may be beneficial.

Overall, we felt that the Weekend Newborn Clinic served our primary goal of providing follow-up of jaundiced infants and reducing unnecessary phototherapy use. Our vision for the future includes using the clinic referral system and space for expansion of other newborn services including primary lactation consultation and newborn educational classes, integrating it with the resident nursery experience to promote continuity, and possibly expanding services to other nurseries in the community with similar follow-up challenges.

CONCLUSIONS

Treatment and discharge practices in the nursery, even for common diagnoses, are largely influenced by availability of reliable follow-up care. Because of their lower socioeconomic level and considerable barriers to health care, our patient population was subject to cautious management of jaundice due to lack of a location for timely follow-up of at-risk infants. The establishment of a Weekend Newborn Clinic proved to be advantageous for reducing the amount of phototherapy initiated over weekends in our term nursery by simply providing a process and a place for close follow-up of at-risk infants. Our unique model of using existing providers, location, and equipment for follow-up of jaundiced infants and incorporating lactation support may be equally beneficial at other similar institutions.

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