

Improving Monitoring and Treatment of Jaundice in Term Infants Discharged from the Postnatal Ward: A Quality Improvement Project

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Abstract

Background: Neonatal jaundice is a common condition affecting many term and preterm infants. If left untreated, there are known long-term health implications, and there are considerable litigation costs to the health service for cases of kernicterus.

Methods and Results: This project aimed to improve the identification of high-risk infants pre-discharge, using a transcutaneous bilirubinometer (TCBR) which is a non-invasive way of screening for jaundice. During the intervention period, from December 2020 to November 2021, from a cohort of 3438 live births, 1763 babies were screened for jaundice; 2% (34 babies) required immediate phototherapy, 1337 (76%) infants were discharged with normal follow-up and 392 (22%) were identified as high-risk, requiring closer monitoring. Of the high-risk babies, 14 (3.5%) infants later required readmission for phototherapy. The median length of stay was shorter in this group compared to the median length of stay in readmissions for phototherapy prior to our intervention. We have found a statistically significant reduction in the need for admission for phototherapy in the intervention group 34/1000 live births in our unit compared to 15/1000 live births ($p = 0.02$).

Conclusion: We conclude that TCBR screening before discharge can identify a proportion of jaundiced infants missed by clinical assessment alone. Closer monitoring and feeding support have resulted in a reduction of infants needing phototherapy. Due to its resource implications, a cost effectiveness study needs to be undertaken before recommendations for wider scale adoption can be made.

Keywords: Monitoring; Jaundice; Infants; Phototherapy

Problem

Our neonatal service is a level 3 service located in the East of England with approximately 900 admissions per year. Our maternity unit oversees an average of 4500 - 5000 live births a year. The general fertility rate of the Luton area is higher than the average fertility rate of the rest of England and Wales. In 2020, there were 77.3 live births per 1000 female population compared to 55.1 in England and Wales [1]. This presents a large pool of infants who could be at risk of jaundice which, if pathological, could result in significant brain injury if not recognised and treated promptly. Kernicterus is a recognised cause of long term disability because of pathological jaundice; litigation costs

are significant in such patients, costing the health service around £12 million per case. This figure is expected to increase in the coming years [2]. In addition, babies are often re-admitted in the first 10 days of life for treatment of jaundice from the community. Readmission has significant implications on use of resources, bed capacity and flow. We postulated that recognising these infants prior to discharge will reduce the need for readmission. Early recognition of jaundice, feeding support, and treatment would decrease their length of stay.

Background

Jaundice is a yellow discolouration of the skin and sclera caused by deposition of excess bilirubin. It is common in newborn infants, occurring in more than 60% of term and 80% of preterm babies under the age of 1 month [3]. Monitoring jaundice levels is important, as occasionally, jaundice can indicate serious underlying pathology. Hyperbilirubinaemia above a certain level can cause its deposition in the brain, resulting in long-term irreversible disability, such as cerebral palsy, visual/hearing impairment and intellectual disability [3].

Newborn jaundice often causes a burden on Children’s Emergency Departments across the country. In our hospital, infants younger than 10 days of age who are referred by the community teams for concerns about jaundice are reviewed on our postnatal ward. Those requiring treatment will be re-admitted with the mother to our transitional care.

Identifying jaundiced infants based on visual appearance is challenging, particularly in darker-skinned populations. Serum bilirubin (SBR) levels are not done routinely, but if the visible discoloration elicits concern in the examining clinician, SBR results are plotted on a gestation-appropriate chart provided by NICE (The National Institute for Health and Care Excellence). Infants who do not require treatment are discharged home and receive standard follow-up in the community on day 5. Single bilirubin measurements pose further challenges; the rate of rise of bilirubin which is a more useful indicator to guide frequency of monitoring cannot be predicted from one-off measurements. To circumvent this problem, our team modified the 36, 37 and 38+ week bilirubin charts with colour-coded areas to indicate the level of risk and recommended time interval for repeat SBR monitoring using data based on NICE guidance (See figure 1). The chart provides guidance on the time interval recommended for repeat SBR measurement. Any TcBR result above the treatment line is confirmed by a plasma SBR using the gas analyser. Treatment with single or double phototherapy is offered on our transitional care unit, but triple phototherapy and exchange transfusion require admission to the neonatal unit.

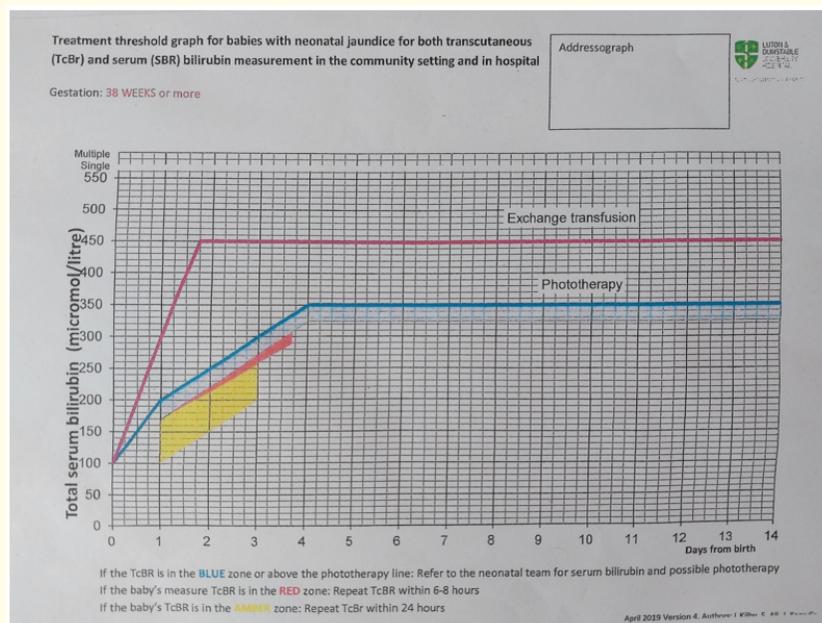


Figure 1: Treatment threshold graph for both TcBR and SBR at 38+ weeks gestation- colour zones adapted by the Luton team [4].

Our project was inspired after observing an increase in the number of infants being admitted for phototherapy during the COVID pandemic in August 2020. This observation may have coincided with our then recent introduction of optimal cord management but may also have been influenced by the impact of the pandemic on the ability of the midwifery workforce to deliver community support. We had become aware that some units were practicing TCBR prior to discharge. Our project's aim was to improve the identification of infants requiring phototherapy using the TCBR machine prior to discharge and to tailor monitoring of infants dependent on the TCBR result. We hoped that closer, bespoke monitoring of high-risk infants and feed optimisation would reduce the need for readmission with jaundice and reduce the length of stay for infants re admitted with jaundice. Use of the TCBR machine is a non-invasive way for screening for jaundice. There appears to be no published literature on any similar Quality Improvement intervention where screening for jaundice is done before discharge.

Methodology

Our intervention period was between December 2020 and November 2021. Infants older than 24 hours and at or above 35 weeks' gestation had their TCBR checked prior to discharge using the Draeger Jaundice Meter JM-105. Infants were not included in the intervention if they were below 35 weeks corrected gestational age, had already undergone phototherapy, had plasma SBR done up to 12 hours before, or were under 24 hours of age at discharge in line with manufacturer recommendations for TCBR accuracy using this device.

The TCBR would then be plotted on the colour-coded bilirubin chart (Figure 1) and the infant will be placed on 3 possible outcome pathways:

1. Discharge with standard community follow up on day 5.
2. Delayed discharge or discharge with closer hospital monitoring if the TCBR plotted in an amber, blue or red zone.
3. Blood gas SBR and phototherapy if TCBR was above phototherapy line.

Demographic data collected for each infant who was eligible for TCBR prior to discharge included name, hospital number, date of birth, corrected gestational age, date and time of TCBR, TCBR result, and outcome pathway.

Monthly delivery data and data on re-attendances and readmissions for jaundice was already available from the midwifery audit team.

In the 3 months (September to November 2020) prior to our intervention we captured monthly deliveries, re-attendances and re-admissions for phototherapy and median length of stay of those readmissions to serve as a baseline for comparison.

To measure engagement with the new process we used as a numerator the infants that had their TCBR checked prior to discharge. The number of infants that were discharged from the postnatal ward over the same time period was used as our denominator. As a balancing measure we calculated the difference in the mean monthly re-attendances between the period prior to the intervention and during the intervention.

Results

There were 3438 deliveries during the intervention period from December 2020 to November 2021. Of these, 1763 (51%) were screened with TCBR prior to discharge. 34 (2%) were identified as needing phototherapy (Outcome pathway 3). There were 392 babies (22%) who were identified as high risk and were monitored more closely. 1337 (76%) babies were discharged with normal community follow up.

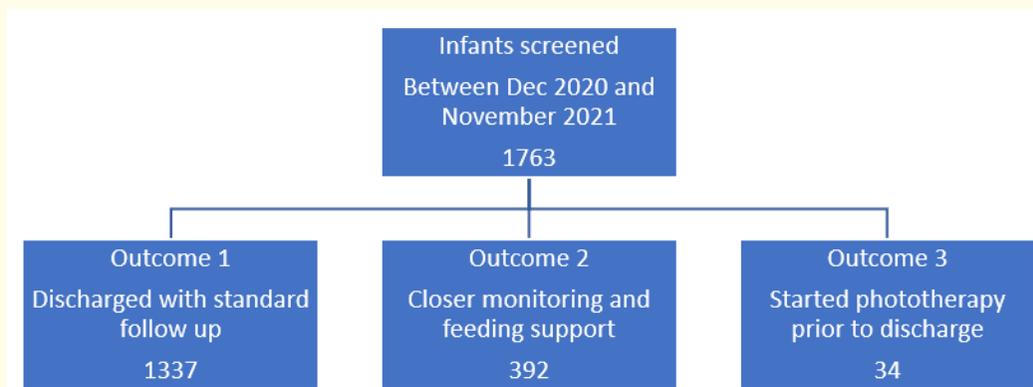


Figure 2: Chart depicting the number of infants screened with TCBR during the 12 months between December 2020 and November 2021 and their respective outcome pathways following the TCBR result.

14 (3.5%) infants who were monitored closely (outcome 2) later needed phototherapy. The median length of stay for infants needing treatment in this category was 1.25 days. This is shorter than the median length of stay of 2 days identified in the pre-intervention group.

	Infants screened with TCBR n = 1763	Infants not screened with TCBR n = 1675	p value
Needed phototherapy	61 (3%)	142 (8%)	p = 0.0001
Needed phototherapy prior to discharge	34 (2%)	N/A	
Needed closer monitoring	392 (22%)	N/A	

Table 1: Showing number of infants screened over the 12 month period between December 2020 and November 2021. Comparison in need for phototherapy treatment in the two groups and the number of infants identified as needing phototherapy prior to discharge or that needed closer monitoring of the serum bilirubin.

During the 3-month period from September - November 2020 (prior to the intervention), there were 157 re-attendances referred from the community, of which 46 (29%) needed readmission for phototherapy. During the same months of the following year, during the intervention there were 210 attendances for SBR measurements with 21 (10%) needing readmission for phototherapy. The overall need for phototherapy in the pre-intervention period was 34 per 1000 live births. Over the 3 comparable months during the intervention, 15 per 1000 live births needed phototherapy (p = 0.02).

Of the 169 that were readmitted during the intervention period, only 13 were not captured by our process. The total number of babies needing phototherapy that had their TCBR checked during the intervention period was 61/1763 (3%). Of those not screened with TCBR 142/1675 (8%) (p = 0.0001) needed later readmission with jaundice.

	Nov-Sept 2020 n = 1316	Nov-Dec 2022 n = 1400	p value
Reattendances for reassessment of jaundice	157	210	
Needed phototherapy	46/157 (29%)	21/210 (10%)	
Phototherapy per 1000 live births discharged from our maternity unit	35	15	p = 0.02

Table 2: Comparison of infants that needed treatment for jaundice during the months of November - September 2020 where no screening was undertaken to the same month period when infants were screened with TCBR.

The mean monthly re-attendances for the SBR measurements per 1000 live births were 127 in the months prior to our intervention and 150 in the same time during the intervention.

Successes

This project was welcomed by the nursery nurses who felt that readmitting infants for treatment of jaundice after being discharged was creating a significant increase in their resources. We postulated that this project would decrease the readmission rate, and therefore this created good engagement from the team to complete the data required. The plan for data collection was initially a three-month period but the nursery nurses continued to engage with data collection and pre-discharge TCBR measurement continued indefinitely due to its perceived benefits.

Challenges

The COVID-19 pandemic and the overstretched community midwifery workforce meant that those infants who needed closer monitoring would need to be brought back to the ward to have their TCBR measured. This impacted on the parents needing to make the trip back to the hospital. The midwifery team support of breastfeeding was also under constraint given the increased workload and slowing of processes, stemming from the need to follow lengthy policies in relation to personal protection during the pandemic.

It has been difficult for the team to capture the TCBR of every baby who was discharged. The large number of babies discharged prior to 24 hours were not eligible for screening. A number of preterm and unwell babies are admitted to the neonatal unit and discharged without admission to the postnatal ward. Early discharges also occur directly from the delivery suite. Capturing this data would require a larger project involving collaboration by delivery suite, postnatal ward staff and neonatal teams.

Discussion

Through this quality improvement project we have captured 34 babies over a 12 month period who needed treatment with phototherapy prior to discharge. The implications of these infants being discharged range from an impact on hospital resources and parental experience because of the need to readmit the baby to potentially missing kernicterus with its implications on potential lifetime disability and litigation claims.

392 babies were identified as high risk and in need of closer monitoring. In these cases, the closer monitoring and the enhanced feeding support offered may have impacted on a statistically significant reduction in the percentage of infants who later needed readmission for jaundice (3% having had their TCBR checked compared to 8% of those that did not have their TCBR checked).

We saw a reduction in median length of stay for infants who were monitored closely when compared with infants needing readmission for jaundice who were not screened (1.25 days vs 2 days). This may be due to early detection and treatment and enhanced feeding support.

Although we have seen an increase in the mean monthly re-attendances for monitoring of TCBR (127 to 150 babies) one could argue that this is a small price to pay to keep infants safe. We recognise that this may have been partly due to the COVID pandemic stretching the ability of community midwifery workforce to monitor TCBR at home. This would have reduced both ward re-attendances and the need for parents to travel to hospital, but we do recognise that this practice has resource implications that need to be tested on a wider scale to determine the cost-effectiveness of this intervention.

TCBR and readmission data were collected for 12 months, from December 2020 to November 2021. This gave us a larger pool of data to determine whether the intervention played a part in a reduction of readmissions for jaundice. We compared data on the same months from September to November 2020 (prior to the intervention) to September to November 2021 to allow for potential effects of seasonal sunlight variations on jaundice levels.

If all the infants were screened, it can be extrapolated that we would have captured 70 (2%) of infants that would have been discharged without recognition for the need for phototherapy.

A major limitation of our project is our inability to identify the impact of our intervention for infants that were discharged to standard follow up. Although our project has identified that the length of stay has been improved, we cannot determine from our data whether this was due to a reduction in the length of phototherapy due to earlier capture or due to closer feeding support. We have also demonstrated a 5% reduction in total readmissions for jaundice in those infants that were monitored but we are unable to determine with certainty whether this is due to the direct effect of the intervention.

Our findings overall indicate that checking TCBR prior to discharge in our cohort of infants has accurately indicated the need for phototherapy in some infants prior to discharge that would otherwise not been reviewed until day 5 of life. We identified a large number of infants who needed bespoke closer monitoring, but this involved an increase in re-attendances for TCBR checking. Some of these infants would have improved spontaneously. Due to its resource implications, this intervention needs a cost-effectiveness study before widescale application.

In our unit, this intervention has been adopted by our nursery nurses as it has decreased their re-admission workload. It has also provided them with reassurance that the baby is safe to be discharged. They also felt that parents feel more reassured when their baby's TCBR is checked prior to discharge.

There are significant limitations to the application of this intervention on a wider scale. In addition to the potential resource implications with this intervention, there is also a need for staff training. It may also result in delaying discharge of a baby with a reading close to the treatment line which may have implications on bed flow and capacity.

Due to the limitations of the TCBR machine, babies discharged before 24 hours would not be eligible for TCBR measurement prior to discharge and may require a review at 24 hours in the community. In our cohort, the majority of infants that were not screened and later readmitted for phototherapy were infants discharged home before 24 hours.

Conclusion

Through this simple quality improvement project we have demonstrated that TCBR screening can identify a proportion of infants requiring phototherapy, that would have been missed by clinical assessment alone. TCBR provides a non-invasive screening tool to guide

management and monitoring of newborn infants with jaundice. Due to its resource implications, this needs to be tested on a wider scale before recommendations for its wide scale adoption can be made.

What is Already Known on the Topic

- Visual assessment of jaundice is inaccurate.
- Unrecognised jaundice can lead to kernicterus.
- Kernicterus litigation costs amount to around £12 million per case.
- Kernicterus can lead to lifelong disability in affected infants.

What this Project Adds

- TCBR monitoring prior to discharge can more accurately identify infants needing phototherapy.
- A number of babies that would otherwise have been discharged needed phototherapy prior to discharge.
- There is a need for a wide scale project to identify the cost effectiveness of wide scale national TCBR screening of newborn infants prior to discharge.

Conflicts of Interest

We declare no conflicts of interest.

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