Peer Reviewed

Phototherapy Threshold: Changes Between 2004 and 2022 AAP Guidelines

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Education Objective:

Pediatricians/providers caring for newborns can use the new 2022 phototherapy guidelines without concern for delayed care or early discharge.

Abstract:

Jaundice is commonly seen in newborns as the physical manifestation of hyperbilirubinemia (HB), which may be treated with phototherapy. Pediatricians follow the American Academy of Pediatrics (AAP) Phototherapy (PTx) guidelines for HB management. AAP launched new guidelines in 2022, raising concerns amongst some pediatricians about leniency before starting phototherapy. A general notion of the new PTx guideline is that newborns are at an increased risk for delayed intervention or a greater readmission potential due to an earlier discharge. We compared hourly phototherapy threshold levels between the previous and the 2022 AAP guidelines to investigate this possibility. Thresholds for infants with a gestational age of 38 weeks within the first 48 hours of life were used to represent the newborns most commonly seen in the nursery. We then generated graphs representing the values and their differences. The differences ranged from 0.5 to 1.8 mg/dL in the group without risk factors and 0.3–1.8 mg/dL in the group with neurotoxicity risk factors. We concluded that the new AAP 2022 phototherapy nomogram is comparable to the old 2004 AAP nomogram. This study should be replicated to compare individual nomograms for 35, 36, 37, 39, and 40 weeks of gestational age.

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Introduction:

Jaundice is a common finding in newborns and is the physical manifestation of hyperbilirubinemia. The elevated bilirubin levels may be physiologic or secondary to ABO/Rh incompatibility, G6PD deficiency, birth trauma (cephalohematoma), breastfeeding, maternal gestational diabetes, prematurity, infrequent feedings, polycythemia, or TORCH infections (1). Hyperbilirubinemia (HB) can become dangerous in newborns if levels of unconjugated bilirubin (lipid soluble) are high enough to cross the blood-brain barrier and deposit in the basal ganglia and brainstem nuclei. This leads to irreversible scarring and damage to the brain tissue, causing bilirubin encephalopathy, leading to kernicterus.

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Phototherapy (PTx) treats HB based on established guidelines, which assess bilirubin levels and correlate with the expected rise and threshold of bilirubin per hour of life, gestational age, and neurotoxicity risk factors. Risk factors include isoimmune hemolytic disease, sepsis, clinical instability within the past 24 hours, and low albumin (<3.0 g/dL) (2, 3). When the threshold is met,

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phototherapy can be initiated to convert unconjugated bilirubin to water-soluble isomers excreted renally. If bilirubin levels do not respond to phototherapy, the next step in management would be an exchange transfusion. Partially hemolyzed and antibody-bound erythrocytes are removed and replaced with normal erythrocytes, decreasing hemolysis and subsequent/further bilirubin elevation. It should be considered in patients with severe anemia, hemolytic disease, or non-hemolytic hyperbilirubinemia that do not respond to phototherapy.

In 2004, the American Academy of Pediatrics (AAP) established guidelines for when phototherapy should be started based on gestational age, neurotoxicity factors, and total bilirubin levels regardless of etiology. Exchange transfusion guidelines were also based on the same parameters. Both were applicable for infants with a gestational age greater than 35 weeks. The implementation of the universal guidelines saw a decreased incidence of hazardous hyperbilirubinemia (>30 mg/dL). These AAP PTx guidelines were updated in 2022.

The leniency in the updated AAP 2022 phototherapy guidelines was often mentioned in social media and internet blogs. While the phototherapy thresholds were increased, the committee combined the best available evidence and expert opinion to reduce the number of infants unnecessarily treated with phototherapy while simultaneously preventing hyperbilirubinemia-associated harm (4). A general notion of the new phototherapy guideline is that newborns are at an increased risk due to delayed intervention or a greater readmission potential because of earlier discharge. We compared hour-by-hour phototherapy threshold levels between the 2004 and 2022 AAP guidelines (2, 3) to investigate this possibility. Our null hypothesis is there is a significant difference between the phototherapy thresholds.

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Methods:

In the previous study (5), a difference of 1 to 3 mg/dL was noted between the 2004 and 2022 threshold bilirubin. Taking the mean of 1 mg/dL and 3 mg/dL, which is 2 mg/dL, we hypothesized that the 2022 bilirubin threshold values would be 2 mg/dL greater than the 2004 guidelines for the first 48 hours of life in newborns born at a gestational age of 38 weeks. As most newborns in the nursery are term infants, we compared phototherapy thresholds for infants with a gestational age of 38 weeks. We further stratified the values based on the presence or absence of neurotoxicity risk factors. The differences were manually calculated and used to generate graphs representing the values and their differences.

Results:

Figure 1 depicts the superimposed nomogram curves for 2004 and 2022. The top panel shows the nomogram of a 38-week infant without any neurotoxicity risk factor for the first 48 hours of life while the bottom panel shows the nomogram of a 38-week infant with a neurotoxicity risk factor for the first 48 hours of life. The differences, displayed as the bottom curve, ranged from 0.5 to 1.8 mg/dL in the group without risk factors. The group with neurotoxicity risk factors has differences that range from 0.3–1.8 mg/dL.

Discussion:

The differences in threshold of the 2004 and 2022 (Δ04–22) noted in our study correlated with the 2022 guidelines of increased bilirubin thresholds by about 1 to 3 mg/dL (5). The concept of delta TSB has been used by Kuzniewicz et al. (6); they defined Δ-TSB as the difference between the 2022 AAP phototherapy and the last inpatient TSB level. They concluded that the Δ-TSB can be used to predict if the bilirubin levels would exceed the AAP's 2022 phototherapy threshold.

Our findings could be relevant to pediatricians and have the potential for clinical utility. We demonstrated that although pediatricians may perceive the new guidelines as liberal, the difference in phototherapy thresholds within the first 48 hours of life is nominal, ranging from 0.5–1.8 mg/dL.

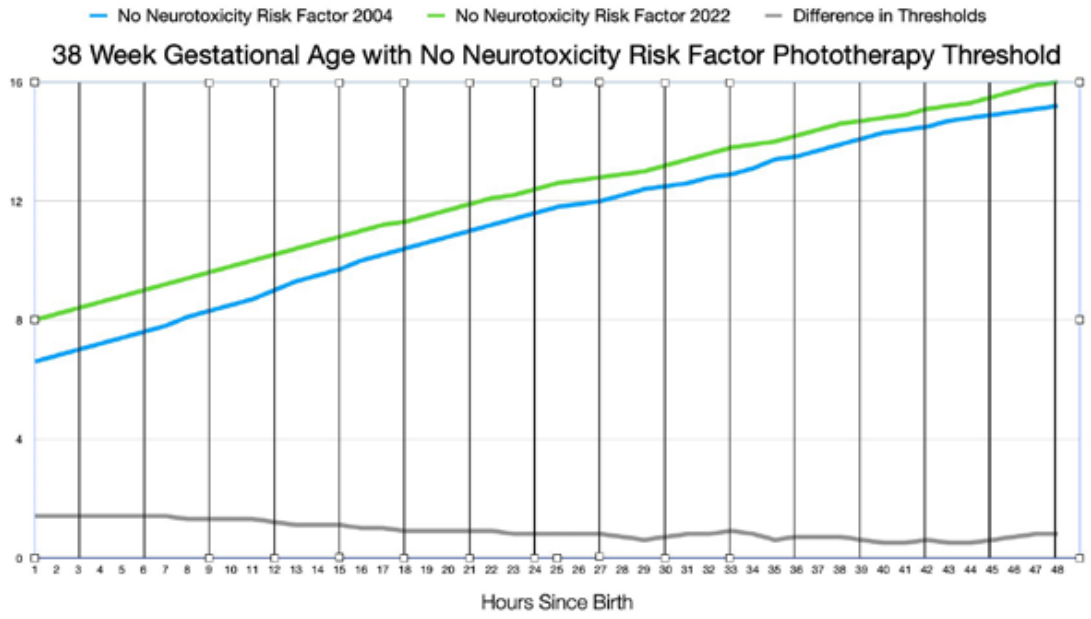
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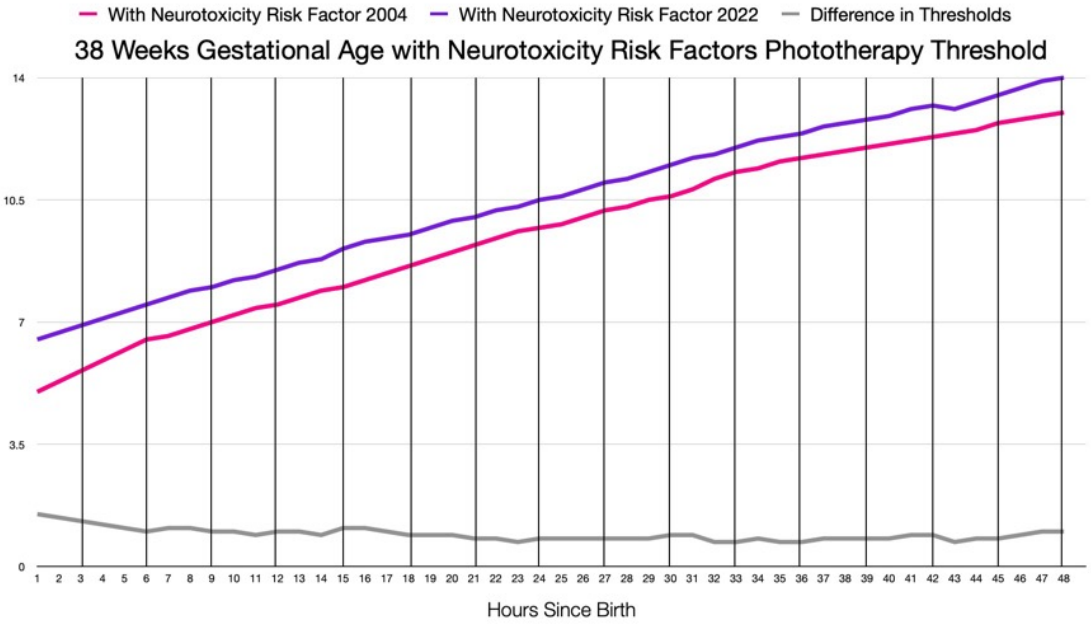
Therefore, our previously stated null hypothesis would be rejected because all the threshold value differences fall below 2 mg/dL. The narrow increases in the 2022 thresholds are reassuring, and pediatricians are not putting infants at risk with the new guidelines.

The study is limited by threshold comparisons confined to a gestational age of 38 weeks. We aimed to assess the thresholds for the most common newborn a pediatrician would care for in

Figure 1: *The top graph compares the hourly phototherapy thresholds for the 2004 and 2022 guidelines. The green line, which maintains a higher threshold, corresponds to the 2022 guidelines. The blue line corresponds to the 2004 guidelines. To highlight the narrow differences, the gray line at the bottom displays the slight differences in thresholds for each hour.*

The bottom graph contrasts with the top by incorporating neurotoxicity risk factors into the bilirubin threshold values. The purple line with higher values predictably corresponds to the 2022 guidelines, while the pink line represents the 2004 guidelines. The bottom gray line highlights the differences between the thresholds.





the nursery. Based on our findings, we expect similar differences in range for all groups of gestational age between the 2004 and 2022 guidelines.

In conclusion, the new AAP 2022 phototherapy nomogram is comparable to the 2004 one. The study should be replicated, comparing individual nomograms at 35, 36, 37, 39, and 40 weeks of gestational age.

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