BENDING THE VALUE CURVE

The Snowball Effect of Low-Value Care

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A 5-day old male infant, born at 38 + 6/7 weeks' gestation, presented to his pediatrician for a jaundice check. He was born via uncomplicated vaginal delivery to a mother with blood type A Rh+, who had a negative antibody screen result, as well as negative group B *Streptococcus*, *Neisseria gonorrhoeae*, and *Chlamydia trachomatis* screening results. He had an unremarkable birth hospitalization. His initial transcutaneous bilirubin at 40 hours and follow-up total serum bilirubin (TSB) at 51 hours, were both in the high intermediate risk zone on the Bhutani hyperbilirubinemia nomogram.[1] Given the lack of hyperbilirubinemia risk factors, he was discharged at 58 hours. A follow-up TSB at 111 hours was 18.5 mg/dL but below the phototherapy threshold of 20.7 mg/dL for a lower-risk infant. Because he was now in the high-risk zone and crossing risk isobars, a TSB was repeated the following day and was 19.8 mg/dL at 129 hours, remaining below the phototherapy threshold of 21 mg/dL. The infant was exclusively breastfeeding and had initially lost 3.4% of his birth weight but had gained 59 g since discharge. At this time, the family, primary pediatrician, and pediatric hospitalist decided to admit for phototherapy.

On admission, he was a well-appearing, uncircumcised boy, with a benign examination except for mild, nonpurulent bilateral eye discharge without conjunctival injection or palpebral edema. He was afebrile, with normal vital signs for age. By report, his mother potentially had an early viral process. Per the admission note, because of his eye discharge, he underwent a complete blood count, C-reactive protein, chemistry, blood culture, and eye discharge culture; because of his mother's possible viral process, he underwent an influenza and respiratory syncytial virus swab. His workup revealed a white blood cell (WBC) count of 11.5 K/μL (30% neutrophils, 51% lymphocytes, no bands); a C-reactive protein of 0.21 mg/dL (reference range 0.02–0.75 mg/dL); a direct bilirubin of 0.8 mg/dL (4% of TSB); blood type O Rh+; and negative results from viral swabs and eye culture. Additionally, the infant underwent a catheterized urinalysis and urine culture because of a concern for a relatively high direct bilirubin, potentially secondary to a urinary tract infection (UTI). His urinalysis results had trace blood, negative nitrites, negative leukocyte esterase, 5 to 10 WBC per high-power field (hpf), and negative bacteria. He was started on triple bank phototherapy and was not started on antibiotics.

After 12 hours of phototherapy, the infant's TSB decreased to 14.8 mg/dL. He received an additional 24 hours of phototherapy, after which his TSB was 10.2 mg/dL, and he was discharged. He breastfed well and gained ~45 g/day during admission, had normal vital signs throughout, and had a benign discharge examination. The day after discharge, the urine culture grew >50 000 colony-forming units (CFUs)/mL of *Staphylococcus epidermidis*. The on-call pediatric hospitalist called the family back to the emergency department for a repeat sepsis workup. On reevaluation, the infant was well appearing with adequate feeding, voiding, and weight gain. The hospitalist decided to only repeat urine studies. Because of the insufficient volume obtained on repeat catheterization, the specimen

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was only sent for culture, and the infant was discharged. The repeat culture grew ~5000 CFUs/mL of *Corynebacterium*, and the infant did well without further intervention.

Several points in this case could be discussed in the context of low-value care: the admission for phototherapy, the sepsis workup, obtaining a urine specimen on the basis of a potentially elevated direct bilirubin, the duration of phototherapy, and the interpretation of the urine culture results and decision for repeated workup. In this article, we will focus on 3 decisions (the decisions to admit for phototherapy, to perform an initial sepsis workup, and to repeat a workup after the positive urine culture) where adherence to published American Academy of Pediatrics (AAP) guidelines could have prevented the spiral of low-value care.

WHY ADMIT FOR PHOTOTHERAPY?

At the time of admission, the infant's TSB was 1.2 mg/dL below the phototherapy threshold recommended by the 2004 AAP hyperbilirubinemia guideline.[2] Although both the guideline and BiliTool specify that thresholds are approximations and that phototherapy can be provided at lower TSB levels,[3] there were several clinical factors that, in conjunction with the guideline, could have supported not admitting this infant. He was feeding well with demonstrated weight gain since discharge, and the rate of rise of his TSB was slowing, dropping from 0.13 mg/dL per hour between 51 and 111 hours to 0.07 mg/dL per hour between 111 and 129 hours. These factors, combined with the family's demonstrated reliability for follow-up, could have kept the infant safely out of the hospital. Although it is noted the admission history that the patient's grandmother, a health care worker, strongly desired admission given the closeness of the bilirubin to the threshold for phototherapy, the extent of the conversation around risks and benefits of admission is unclear.

New literature since the publication of the AAP hyperbilirubinemia guideline suggests that even significantly elevated bilirubin levels are less harmful than previously thought,[4–6] whereas phototherapy itself is being investigated for potential physiologic harms, including damage to DNA and links to childhood cancer.[7–9] Admission for phototherapy may also disrupt breastfeeding and maternal-child bonding.[10–12] Furthermore, based on work by Newman et al,[13] for a male infant that was 38 weeks' gestation and >72 hours old with a TSB 2 mg/dL to <1 mg/dL below the AAP phototherapy threshold, the number needed to treat to prevent 1 infant from reaching the AAP's exchange transfusion threshold is 1840. Importantly, this is not the number needed to treat to prevent the true outcome of concern, chronic bilirubin encephalopathy, which is likely much higher, because the estimated threshold of TSB for causing chronic bilirubin encephalopathy is at least 5 mg/dL above the exchange transfusion threshold.[5]

Here, the preference of at least 1 family member weighed significantly into the decision to admit for phototherapy. Shared decision-making includes exploring patient and family preferences around 2 or more medically reasonable options, after clinicians provide explicit information about benefits, risks, and costs of each option.[14–16] Given the current literature, if an infant does not meet the published threshold for phototherapy, it seems questionable as to whether the option of admission should be offered to the family at all. However, when a discussion around the need for phototherapy does occur, sharing emerging data on how conservative current thresholds are, as well as the possible harms of phototherapy, may help prevent unnecessary admissions, such as in this case.

WHY PERFORM A PARTIAL SEPSIS WORKUP?

The AAP recommended workup for an infant admitted to the hospital for phototherapy is a blood type, Coomb's, complete blood count with smear, and a direct bilirubin, unless the history and/or presentation suggest sepsis.[2] This patient had normal vital signs and was well appearing yet underwent a fairly extensive workup, with the admitting physician citing factors in the history and physical that do not indicate an increased risk for a serious bacterial infection. The nonpurulent eye discharge, without additional signs of conjunctivitis and the mother's negative gonococcal and *Chlamydia* screen, is unlikely to represent ophthalmia neonatorum, which in isolation would be a rare presentation of sepsis anyway.[17–20] Furthermore, the elevated direct bilirubin cited as possibly being secondary to a UTI, was not actually elevated per the AAP guideline, which defines an abnormal direct bilirubin as >1.0 mg/dL if the TSB is ≤5 mg/dL, or >20% of a TSB >5 mg/dL.[2] Therefore, there was no indication for additional workup beyond routine hemolysis laboratories.

HOW SHOULD THE URINE CULTURE RESULTS BE INTERPRETED?

The 2011 AAP clinical practice guideline for febrile UTIs states that the diagnosis of UTI "is made on the basis of the presence of both pyuria and at least 50 000 colonies per mL of a single uropathogenic organism."[21] It describes that "organisms such as *Lactobacillus* spp., coagulase-negative staphylococci, and *Corynebacterium* spp. are not considered clinically relevant urine isolates for otherwise healthy, 2- to 24-month old children." Although this patient is a neonate and does not technically fall within the guideline's purview, through our literature review we could find no reported cases of *S epidermidis* causing true community-acquired UTI in the neonatal period. In fact, there are limited case reports of *S epidermidis* causing community-acquired UTI in the entire pediatric age range.[22,23]

There is an argument to be made for reevaluating the infant after the urine culture results were received. He was an uncircumcised neonate, with 5 to 10 WBC/hpf on a urinalysis that grew >50 000 CFUs/mL of a single species. According to Schroeder et al,[24] pyuria >3 WBC/hpf may have a sensitivity and specificity of up to 96% and 91%, respectively, in infants <3 months old, leading to a notable positive likelihood ratio of 10.7. However, based on the guidelines discussed previously, the urine studies were not indicated, and the organism was not a uropathogen. Because

the infant continued to be well appearing on follow-up without having received previous antibiotics, the initial urine culture results almost certainly represented either contamination or asymptomatic bacteriuria, for which there is no evidence to justify a repeat catheterization.

CONCLUSIONS

Although no guideline fits every patient or replaces clinical judgment, evidence-based practice guidelines allow for meaningful discourse around current literature and can promote value-based shared decision-making.[25,26] This case highlights how 1 decision, albeit seemingly benign, can lead to rapid snowballing of low-value care. For this infant, adherence to published guidelines at 3 separate points could have prevented or halted the low-value care spiral.

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