

Kernicterus: A Diagnosis Lost and Found

Susan Carr
Newsletter Editor

Between 60% and 80% of newborn babies develop jaundice during the first week of life. Most cases resolve with treatments that include phototherapy and transfusion. Left untreated, the yellow pigment found in bile, or bilirubin, that causes jaundice may in a small percentage of cases reach levels high enough to cause permanent brain damage and a disorder called kernicterus.¹

Attitudes toward neonatal jaundice have evolved since the early 1950s, when the connection between high levels of serum bilirubin—hyperbilirubinemia—and kernicterus was first recognized.² At that time, therapy was used to maintain a serum bilirubin level of no more than 20 mg/dL in order to prevent kernicterus.^{3,4} That approach was successful, and by the early 1990s, cases of kernicterus were rarely seen in the United States. It appeared that kernicterus had been eradicated, and attitudes toward neonatal jaundice relaxed.^{5,6}

The Re-emergence of Kernicterus

When the incidence of kernicterus started to increase,⁶ parents of afflicted children were among the first to sense that awareness of the disorder had fallen between the cracks. Comparing their stories, they identified health-system failures that had injured their newborn babies and continued to put others at risk. Those gaps included failing to screen and treat dangerous levels of bilirubin and to prepare parents to recognize that their babies' jaundice needed urgent evaluation.⁷

A series of unrelated developments had allowed kernicterus to re-emerge and slip under the radar of most physicians.

The median length of inpatient care for mothers and newborns decreased from four days in 1970 to two days in 1992.⁸ Therefore, babies who developed dangerous levels of bilirubin, which peaks in newborns between days three and five, were already home, being cared for by mothers who had been encouraged not to worry about jaundice.

In the journal of the American Academy of Pediatrics (AAP) in 1992, Newman and Maisels

advised treating jaundice in newborns less aggressively than had been previously recommended.⁵ Guidelines published by AAP in 1994 concurred, increasing the level of bilirubin considered to be safe in newborns and recommending that physicians evaluate jaundice by noting the degree of yellow in the baby's skin based on direct visual observation.⁹ That shift became known as the "kinder, gentler approach" (taken from the title of the 1992 article) and was driven by concern that babies were being over-treated with phototherapy and transfusion, especially given an assumption that kernicterus was extremely rare.

Consumer Activism Leads to New Standard of Care

Sue Sheridan of Boise, Idaho, was among a group of eight mothers who witnessed the re-emergence of kernicterus through experience with their own children, and others who had been misdiagnosed as cases of hearing loss or cerebral palsy.¹⁰

In 2000, they founded the Parents of Infants and Children with Kernicterus (PICK) to alert

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medical professionals and parents that jaundice posed a more significant threat to newborns than was currently recognized and that harm could be avoided through universal screening.

In 1995, Sue Sheridan's first child, Cal, was healthy at birth and quickly developed jaundice. Clinicians in the hospital noted his jaundice at 16 hours but made light of the condition and discharged him home. Two days later, Sheridan became concerned that he was disinterested in feeding and seemed lethargic, which are classic symptoms of hyperbilirubinemia. Cal's pediatrician prescribed an antibiotic for an ear infection that he believed was causing his symptoms, which did not improve. Sheridan then took four-day-old Cal back to the hospital, where his bilirubin level—now dangerously high—was tested for the first time. On the fifth day, Cal exhibited signs of brain damage associated with kernicterus, which was not recognized by clinicians at the hospital. He was discharged four days later as a "well child" and diagnosed with kernicterus seven months later by a specialist in Seattle.^{11,12}

Following Cal's diagnosis, Sheridan became an advocate for safer care. In 2000, she testified about her family's experience with kernicterus at the First National Summit on

Patient Safety and Medical Errors,¹³ and her story was featured in *USA Today*.¹⁴ Sheridan heard immediately from other mothers of children with kernicterus. Galvanized by the similarities in their stories, they formed PICK. Ten days later, they traveled to a meeting of the AAP where the reemergence of kernicterus was already on the agenda.¹¹

Over the next four years, Sheridan and members of PICK led a campaign to raise awareness about the dangers of newborn jaundice and hyperbilirubinemia, change standards for screening newborns, educate new parents, and improve the diagnosis of kernicterus. Milestones along the way included *Sentinel Event Alerts* from The Joint Commission,^{15,16} "never event" designation by the National Quality Form,¹⁷ and support from researchers and government agencies.¹⁰ PICK saw much of what they had asked for in an updated clinical practice guideline for the management of hyperbilirubinemia issued by the American Academy of Pediatrics in 2004.¹⁸

Highlights of the new guidelines included lower thresholds for starting therapy for jaundice, vigilant assessment of serum bilirubin levels according to age by hours of life,¹⁹ and permission for nurses to request blood tests for bilirubin levels without a physician's order. The guidelines also stressed the importance of follow-up neonatal exams post-discharge, during the period when bilirubin levels usually peak.

Timeline of events leading to improved screening, diagnosis, and prevention of problems related to neonatal jaundice

1992	Pilot Kernicterus Registry established. ²⁰
1994	AAP publishes "Practice Parameter: Management of Hyperbilirubinemia in the Healthy Term Newborn." ⁹
2000	Parents of Infants and Children with Kernicterus (PICK) formed. Members attend symposium on kernicterus prior to AAP Annual Meeting. ¹¹
2001	"Strategies for a System-wide Approach in the Management of Hyperbilirubinemia to Prevent Kernicterus" organized by PICK, co-sponsored by Pennsylvania Hospital, with The Joint Commission, AAP, National Institutes of Health, plus other organizations and leading researchers. ^{13,20} The Joint Commission publishes <i>Sentinel Event Alert #18</i> "Kernicterus threatens healthy newborns." ¹⁵ CDC publishes "Kernicterus in Full-Term Infants—United States, 1994–1998" in <i>JAMA</i> . ¹⁰
2002	National Quality Forum includes kernicterus and bilirubin levels >30 mg/dL in full- and near-term babies as a "never event" on its list of Serious Reportable Events. ¹⁷ Responding to recurrence of hyperbilirubinemia, Intermountain Health Care initiates universal bilirubin screening of full- and near-term babies to be implemented system-wide by December 2003. ²²
2004	AAP updates "Clinical Practice Guideline: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation." ¹⁸ The Joint Commission publishes <i>Sentinel Event Alert #31</i> , "Revised guidance to help prevent kernicterus." ¹⁶
2005	Hospital Corporation of America (HCA) study shows significantly fewer babies with dangerously high bilirubin numbers after implementing universal bilirubin screening by blood test. ²³

The Role of Research

In their campaign, PICK members focused on preventing harm to future babies and families, not initially on research. According to Sheridan, who is currently director of patient engagement for the Patient-Centered Outcomes Research Institute:

As mothers and activists, we weren't thinking about research, we were thinking about a solution. Our solution was to implement a universal bilirubin test. But when we went to policy makers, they said, "We agree we need to explore this, but where is the evidence?" (Oral communication, February 2015).

PICK took a step back from its campaign to work with researchers, including Vinod Bhatani, MD, at the BIND (Bilirubin Induced Neurological Dysfunction) Center at Pennsylvania Hospital, to learn more about the incidence of jaundice and kernicterus. PICK families shared their children's medical records with researchers, and Bhatani worked with the Hospital Corporation of America to assess how many cases of kernic-

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terus were occurring in its hospitals and to measure the preventive effect of universal screening.²³

According to Bhutani, now professor of pediatrics at Stanford Children's Health and the Stanford University School of Medicine in California, the attention that Sheridan and other members of PICK brought to the re-emergence of kernicterus led to better understanding and evidence. Bhutani and others believe that known cases of kernicterus may be the "tip of an iceberg" of more subtle neurological injuries resulting from high levels of bilirubin. Work on preventing harm from hyperbilirubinemia continues, including a focus on better screening and diagnostic tools.

In PICK's campaign to prevent hyperbilirubinemia and kernicterus, consumers—parents in this case—took the lead, partnering with leaders across healthcare to create change. Sheridan is grateful she and others members of PICK "didn't know any better" than to approach national healthcare leaders directly. Planning a roundtable on behalf of PICK in 2001, Sheridan invited policy makers, government officials, and industry leaders by telephoning them individually.¹¹ As each accepted and referred her to other leaders, the effort snowballed into a pivotal event that drew a broad and powerful group of participants who were not accustomed to working together.

The changes in practice achieved by the parents of PICK is a unique example of how patient advocates were able to successfully mobilize all of the relevant stakeholders to improve the diagnosis of this treatable condition.

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Mark Graber Receives Prestigious National Award

By Hardeep Singh, MD,
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Congratulations to Dr. Mark L. Graber, recipient of the 2014 John M. Eisenberg Patient Safety and Quality Award for Individual Achievement.

Mark L. Graber, MD, founder of the Society to Improve Diagnosis in Medicine (SIDM) and the founding editor of the new international journal, *Diagnosis*, was recently named the recipient of the 2014 John M. Eisenberg Patient Safety and Quality Award for Individual Achievement. Mark will receive the award at National Quality Forum's 2015 Annual Conference on March 23-24, 2015, in Washington, DC. This prestigious award is in recognition of his longstanding and tireless efforts to bring the importance of diagnostic error to the forefront of the current patient safety movement. While a brief account of his accomplishments follows, I can best summarize that I consider Mark to be the "father of the modern diagnostic error field." His accomplishments and highly influential leadership to move us forward are truly deserving of this recognition.

Mark's vision and passion for reducing diagnostic error have been guiding forces behind many national initiatives. Mark founded both the Diagnostic Error in Medicine Conference series as well as SIDM in order to bring diverse stakeholders together to work on reducing diagnostic error. These forward-thinking contributions ul-

timately helped place diagnostic errors on the radar screen of many patient safety advocates and leaders.

Through many of his activities, Mark is now helping shape initiatives to impact research, education, policy, and practice related to diagnostic safety. Last year, he was appointed as a member of the Institute of Medicine Committee on Diagnostic Error in Health Care. This committee will soon propose national recommendations to help better understand and reduce diagnostic error. Mark has also invested a considerable amount of time as a mentor to the next generation of leaders.

On a more personal note, I have learned a lot from Mark and have to admit that his inspiration is "infectious." Mark is selflessly dedicated to both the field of diagnostic error and his colleagues, and many of us have been very fortunate to thrive under his leadership. He has helped develop a growing community that will carry our agenda forward in the future. Please join me in congratulating Mark, our Society leader, dear friend, and esteemed colleague. It's a proud moment of honor for all of us, our entire community, and especially our patients.

NEWS FROM THE FIELD

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Diagnosis. 2015;2(1):1-77.
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The February 2015 issue of SIDM's peer-reviewed journal, *Diagnosis* (ISSN:2194-802X), is available online. Now in its second year, the free, quarterly journal advances the practice of diagnosis through research and commentary.

In a review article, Shenvi and El-Kareh survey published literature for "trigger" criteria that could be used to automatically detect inpatient diagnostic errors. They also use clinical scenarios to develop a conceptual framework for categorizing the triggers according to outcomes of hospital-based diagnostic errors.

Shenvi and El-Kareh acknowledge that this represents only initial work on the long-term challenge of identifying inpatient diagnostic errors retrospectively and in real time. Though electronic records offer hope for the future, this work is beyond the capability of most current implementations. Other challenges include the

fundamental need to agree on the definition of diagnostic error. In an accompanying editorial, Bhise and Singh add insufficient research funding and reimbursement incentives to the authors' list of challenges.

In "Types of diagnostic errors in neurological emergencies in the emergency department," Dubosh et al study cases from one urban, tertiary academic medical center. They categorize the errors in these cases as caused by knowledge gaps (45.2%), cognitive errors (29%), or system-based errors (25.8%) and use case examples to illustrate these concepts.

This issue of *Diagnosis* also includes a 46-page supplement comprising abstracts presented at the Diagnostic Error in Medicine 7th International Conference held in Atlanta in September 2014. The studies were presented either as oral abstracts or poster presentations at the conference.