CoSense End-Tidal Carbon Monoxide (ETCO) Monitor

October 2024

Device Overview

Hyperbilirubinemia in neonates is caused by elevated total serum bilirubin and appears as yellow discoloration of skin, mucous membranes, and/or sclera. [1] If left untreated, it can result in encephalopathy (acute symptoms of neurotoxicity) and/or kernictus (permanent disabling manifestations of neurotoxicity). [2,3] Jaundiced neonates with hemolysis present have increased risk for severe hyperbilirubinemia with susceptibility to toxicity and the American Academy of Pediatrics (AAP) recommends determination of hemolysis in the management of newborn hyperbilirubinemia. [4] ETCO, corrected to ambient carbon monixide (ETCOc), is a marker of hemolysis and bilirubin production. [5] According to the manufacturer CoSense is a non-invasive, painless, and rapid method for accurate measurement of ETCOc in newborns, which minimizes disruptions to family bonding and enhances outcomes by reducing the length of stay (LOS), unnecessary phototherapy, blood tests, and readmissions. [6]

Actions for Consideration

PARTNER

ENGAGE SUBJECT MATTER EXPERTS
Include neonatologist(s), pediatricians, respiratory therapy, nursing, laboratory, quality personnel, and value analysis leaders on multidisciplinary team.

CONSIDER GUIDELINES FOR USE
Assess integration into existing neonatal hyperbilirubinemia and specific unit protocol(s).

UNDERSTAND CONCERNS
Ensure prompt response to questions/concerns. Consider product trialing if consensus cannot be achieved.

CONNECT

SEEK CLINICAL IMPACT
Share and discuss available evidence including potential for prediction, early intervention, and treatment plan impact.

CONDUCT ANALYSIS
Consider cost, reimbursement, potential to alter outcomes, LOS, readmissions, possible reduced need for lab resources, and patient satisfaction.

DETERMINE POPULATION
Work with key stakeholders to determine appropriate patient population including age (corrected) and risk stratification.

COMMUNICATE

EDUCATE AND TRAIN
Provide hands-on equipment training for nursing and respiratory. Include education on correlation between ETCOc, hemolysis, and hyperbilirubinemia.

PLAN AHEAD
Assess quantity needed per historical volumes. Engage supplier for training and bedside support during go-live.

FOLLOW-UP FOR FEEDBACK
Determine metrics and goals, including cadence for reporting. Communicate contact(s) for troubleshooting/questions.

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Professional Society Statements & Clinical Practice Guidelines

American Academy of Pediatrics

AAP Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation, includes the following related to rate of hemolysis, CO monitoring, and neonatal jaundice (Key Action Statement 7):

"If more than one total transcutaneous or serum bilirubin measure is available, the rate of increase may be used to identify infants at higher risk of subsequent hyperbilirubinemia. A rapid rate of increase (≥0.3 mg/dL per hour in the first 24 hours or ≥0.2 mg/dL per hour thereafter) is exceptional and suggests hemolysis. In this case, perform a DAT if not previously done.

If available, measurement of end-tidal carbon monoxide production, corrected for ambient carbon monoxide, is a potentially useful method for quantifying hemolysis. Carbon monoxide is produced in equimolar amounts with bilirubin when heme is catabolized to bilirubin." Found here. [3]

Clinical Evidence

There are many studies evaluating the correlation between ETCO and hemolysis and its significance in neonatal jaundice treatment and/or outcomes. A sample is included below.

A 2021 prospective study by Bhatia et al. aimed to evaluate the correlation between hemolysis and ETCOc, and its pertinence in neonates at risk for significant hyperbilirubinemia. Neonates greater than 35 weeks with birthweight greater than 2,000 grams that had either blood group incompatibility, phototherapy need within 7 days of life, or G6PD deficiency (N=50) were included. ETCOc values were obtained at 65.9 (±22) and 86.3 (±19.6) hours of life (utilizing CoSense). The marker of hemolysis was chosen as the higher of the two values. They concluded that "higher ETCOc values ≥1.8 ppm are suggestive of an increased hemoglobin breakdown due to hemolysis and they are associated with significant hyperbilirubinemia. Neonates with higher ETCOc values ≥1.8 ppm may need increased surveillance, close monitoring, and early treatment." Authors note the need for further studies with larger samples and evaluation of cost effectiveness are necessary for widespread adoption. United Italian Trading Corporation (Pte.) Ltd. provided the equipment utilized. [4]

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Clinical Evidence continued

A 2024 prospective study by Yang et al. sought to evaluate the predictive value of ETCOc in neonatal hyperbilirubinemia (due to hemolysis) within 48 hours of birth. Newborns greater than 35 weeks and above 2000 grams at high risk for hemolytic disease (either from blood group incompatibility or G6PD deficiency) were included (N=386). ETCOc was measured (using CoSense) within 24 hours after birth (D1-ETCO) and again 24-48 hours after birth (D2-ETCO) with a ten day follow up period to evaluate for reported hyperbilirubinemia. The subjects were divided into cohorts based on jaundice within 7 days after birth (hyperbilirubinemia group) and a "normal jaundice" group. The hyperbilirubinemia group was further divided into hemolytic and nonhemolytic. Area under the curve (AUC), along with receiver operating characteristic (ROC) curve, were used to evaluate the predictive value. The AUC for D1-ETCO was 0.958 (95% Confidence Interval [CI] 0.929–0.987), for D2-ETCO was 0.862 (95% CI 0.763–0.961), and for maternal anti-A/B IgG titers was 0.894 (95% CI 0.828–0.960). Pearson correlation on the indexes of ETCOc and hospitalized neonates with hemolytic disease showed that higher ETCOc correlated with faster rise in jaundice, increased length of stay, higher reticulocyte count, and lower hemoglobin after admission. They concluded that ETCOc is higher in infants who develop hyperbilirubinemia due to hemolysis than those with jaundice from other causes as well as the "jaundice normal" newborns and that ETCOc value (within 48 hours) may be predictive of the absence of hemolytic newborn jaundice. "Furthermore, the higher the ETCO, the more severe hemolysis in newborns, the faster the rate of bilirubin rises, and the higher the risk of developing into severe hyperbilirubinemia." There were no limitations listed for this study. Capnia provided the equipment utilized. [7]

A 2023 prospective study by Zahn et al. aimed to assess the predictive value of ETCOc in the duration of phototherapy for infants with serum total bilirubin (STB) levels requiring phototherapy for risk category and age. Infants greater than or equal to 35 weeks and 2000 grams, as well as greater than 3 and less than 7 days old, prescribed phototherapy were included (with exclusion criteria for comorbidities [N=103]). ETCOc and STB were obtained within 6 hours of birth with STB repeated prior to discharge. ROC and AUC curves were used for predictive values. At a specificity of 80%, the sensitivity for STB was 31.3%, ETCOc 68.8%, and the combination of both was 68.8%. They increased to 68.8%, 81.3%, and 81.3% at a specificity of 50%.

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Clinical Evidence, continued

The AUC of STB was 0.577 (P value 0.33, 95%CI 0.424-0.73), ETCOc 0.765 (P value 0.001, 95% CI 0.624-0.906), and the combination of both was 0.777 (P value 0.001, 95% CI 0.643-912). They concluded that ETCOc was reliable for predicting prolonged phototherapy duration and that "the assessment of disease severity using ETCOc values is extremely meaningful, not only for physicians to make treatment plans but also to improve the adherence of the children's families to these plans." Limitations included potential selection bias, sample size, and short duration of trial. [8]

Systematic search terms: ETCO monitoring and hemolysis, ETCO monitoring and hyperbilirubinemia, ETCO and neonatal jaundice, Cosense and Hyperbilirubinemia
Databases: Pubmed, CINAHL
Studies published from: 2019-2024

FDA Approval

The CoSense ETCO Monitor has an updated FDA 510k approval, as of July 2015 (K151107), as indicated for:

"...the monitoring of carbon monoxide from endogenous sources (including hemolysis) and exogenous sources (including CO poisoning and smoke inhalation) in exhaled breath. The end tidal carbon monoxide level can be used for the monitoring of carbon monoxide in medical conditions in which the rate of hemolysis may be relevant. It is also for use in smoking cessation programs and can be used for the screening of CO poisoning and smoke inhalation." Found here. [9]

Prior approvals include K121768 (October 2012) and K130036 (January 2014). [10]

HealthTrust Clinical Resources

Allow us to connect you with the resources you need. Examples for this category include resources on physician engagement, value analysis, and product trials.

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Clinical Insights: HealthTrust Clinical Advisory Boards and Member Insights

The HealthTrust Perinatal and Respiratory Clinical Advisory Boards, as well as members within the Healthtrust Huddle, provided insights regarding the use of this product. [11]

Clinical Advisory Board and Healthtrust Huddle Insights*

Potential Benefits:

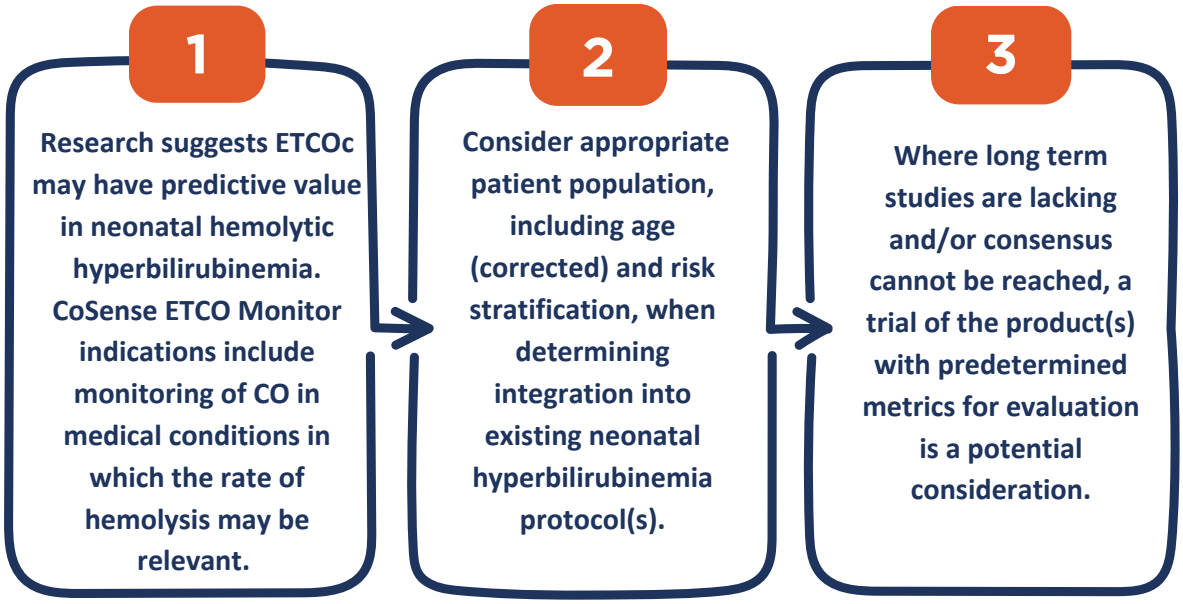
- Non-invasive measurement
- Increased parental satisfaction
- Less disruption in bonding
- Takes as little as five minutes
- Shorter alert times
- Earlier detection
- Decreased length of stay

Potential Disadvantages:

- Cost of equipment purchase and disposables
- Limitations on populations used for
- Storage limitations for equipment
- Risk of inadequate supply during peak volumes (would need a surge plan)
- Concerns for accuracy based on "breath alone"
- Learning curve for accurate use of equipment, results, and algorithm changes

***Of note, no participants relayed direct experience utilizing CoSense. Feedback based on review of FDA indications for use, product summary, and manufacturer website.**

Summary



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References

1. Ansong-Assoku B, Shah SD, Adnan M, Ankola PA. Neonatal Jaundice. In: *StatPearls.* Treasure Island (FL): StatPearls Publishing; February 20, 2023. Accessed October 3, 2024. https://www.ncbi.nlm.nih.gov/books/NBK532930/
2. Karimzadeh P, Fallahi M, Kazemian M, Taslimi Taleghani N, Nouripour S, Radfar M. Bilirubin Induced Encephalopathy. *Iran J Child Neurol*. 2020;14(1):7-19.
3. Kemper AR, Newman TB, Slaughter JL, et al. Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation. *Pediatrics*. 2022;150(3). doi:https://doi.org/10.1542/peds.2022-058859
4. Bhatia A, Chua MC, Dela Puerta R, Rajadurai VS. Noninvasive Detection of Hemolysis with ETCOc Measurement in Neonates at Risk for Significant Hyperbilirubinemia. *Neonatology*. 2020;117(5):612-618. doi:10.1159/000509405
5. Stevenson DK, Vreman HJ, Wong RJ, Dennery PA, Contag CH. Carbon monoxide detection and biological investigations. *Trans Am Clin Climatol Assoc*. 2000;111:61-75.
6. CoSense® ETCOc Monitoring: Jaundice Management for Newborns. Capnia. Published May 22, 2024. Accessed October 7, 2024. https://capnia.com/cosense-product
7. Yang C, Cheng X, Lin B, Yang Y, Yu Y, Fu Y. Predictive value of end-tidal carbon monoxide concentration (ETCOc) within 48 hours after birth in neonatal hyperbilirubinemia caused by hemolysis. *Research Square*. Published online March 12, 2024. doi:https://doi.org/10.21203/rs.3.rs-4007734/v1
8. Zhan YL, Peng HB, Jin ZC, et al. Higher ETCOc predicts longer phototherapy treatment in neonatal hyperbilirubinemia. *Frontiers in Pediatrics*. 2023;11. doi:https://doi.org/10.3389/fped.2023.1154350
9. 510(k) Premarket Notification. Fda.gov. Published 2024. Accessed October 3, 2024. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm?ID=K121768
10. 510(k) Premarket Notification. Fda.gov. Published 2019. Accessed October 3, 2024. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm
11. HealthTrust Clinical Advisor Board and Member Survey. Collected October 1 through October 14, 2024.

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