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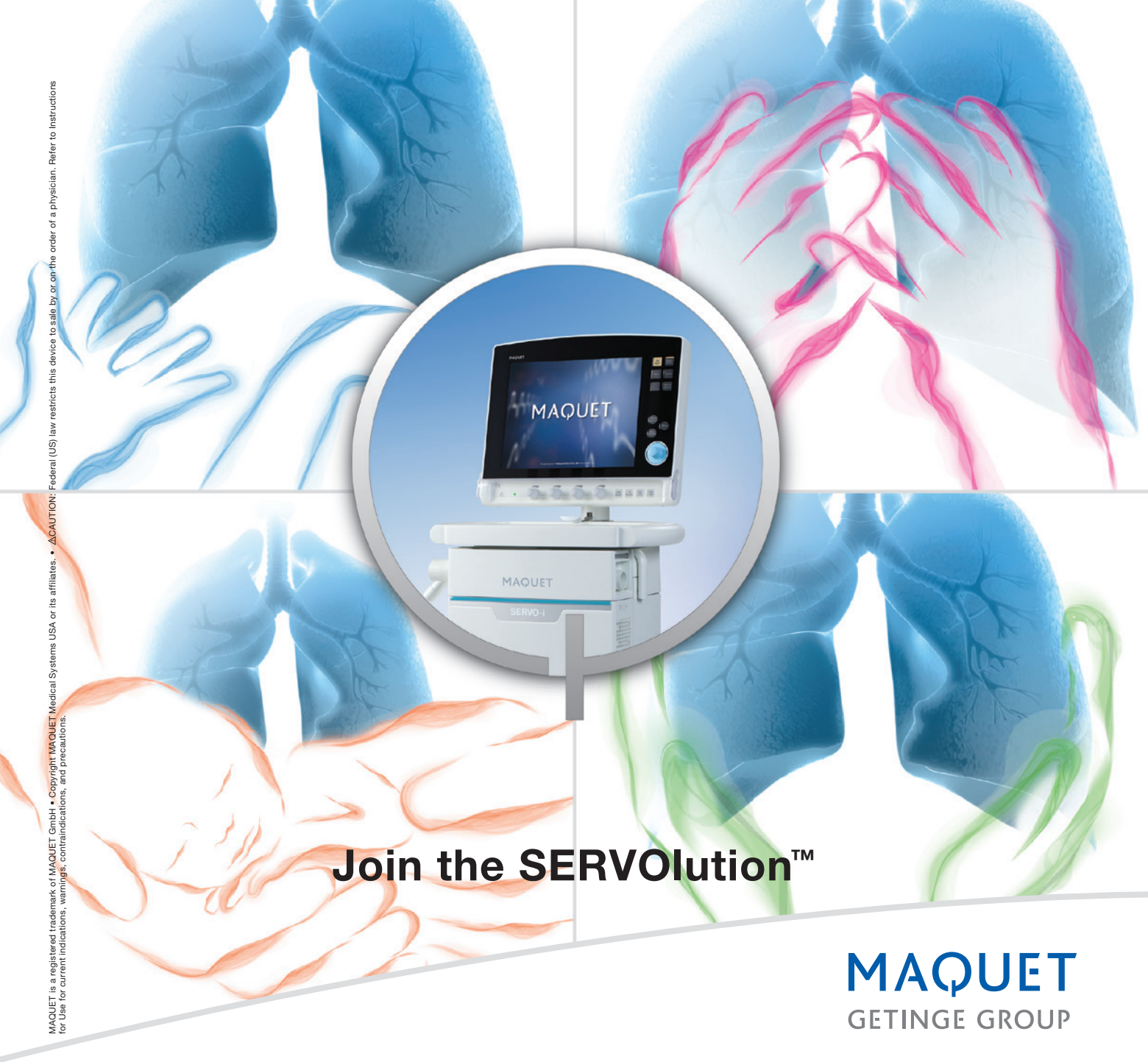

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Evolution vs Extinction

Is the rapid growth of surfactant use and NIPPV leading to the extinction of neonatal mechanical ventilation skills sets?

Dave Swift, RRT

As surfactant use became more mainstream and a first-line intervention, non-invasive ventilation quickly evolved in its delivery systems and interfaces. These two changes created a tipping point in neonatal ventilation. Instead of a prolonged intubation and ventilated state, the neonate is intubated, given surfactant and rapidly extubated to NIPPV. The duration of NIPPV is actually reduced as the effects of the surfactant administered improves compliance. This is repeated right across neonatal ICU's across North America.

At the Ottawa Hospital's Civic Campus Rich Little Special Care Nursery (an enhanced level 2 NICU), in the last two years, there has been a 60% reduction of mechanical ventilation and the average time on NIPPV is down to 36-48 hours with a large number <12 hours. The ability to maintain intubation skills and mechanical ventilation skills is in doubt. The effects are being repeated across North America and being noticed by leaders in the neonatal world and efforts to ensure these skills are maintained are mixed. Therapists are expressing concerns as they see their skills erode over time and their ability to safely deliver the mandated patient care is not seen as sustainable. The government ministry (Ontario ministry of Health and Long Term Care) responsible for health care has closely monitored the situation and is considering implementation of mandatory transfer guidelines to ensure that intubated neonates, after 48 hours, and not being actively weaned, are transferred to level 3 centers to ensure that the skills sets required are maintained and level of care provided appropriate to the needs of the patient.

Such rapid evolution in patient care has rarely been seen in the Respiratory Therapy profession and many have not noticed or acknowledged the rapid changes occurring. As technologic advances improve the delivery of NIPPV, the interfaces available reduce risks of damage and patient response capabilities improve, the utilization of mechanical ventilation will drastically drop further. Evolution or extinction, either way the changes are accelerating and show no sign of slowing. Our understanding of the role of NIPPV in the neonates needs to keep pace with this evolution. We must embrace the changes or be left behind as other clinicians rise to meet the needs.

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Current Feeding Practices in NICU: Evidence-Based or Not?

Rahmi Örs, MD

Nutritional support can play a significant role in improving survival rates and outcomes of extremely premature infants. The best management of the first golden days/weeks of nutrition in a preterm infant's life is of vital importance. Nutritional practices also are important to manage the other important parameters (thermoregulation, cardiopulmonary support etc.).

The sucking-swallowing-breathing coordination in premature infants less than 32-34 weeks of gestational age is not usually present. These premature babies do not have fully developed intestines. Parenteral support is required during the first one to two weeks of life to complete the nutritional requirements of preterms.

Nutritional practices show marked differences in neonatal intensive care units in different countries. Current practices in nutrition support are not largely evidence-based. Preference is primarily based on personal choice, or unit policy. At present there are limited data on simple applications associated with nutrition.

Enteral tube feeding is most preferred and the safest route to feed the preterm infants. It is common practice in NICU. The using of the nasogastric route for tube feeding may be easier to secure, but it causes partial obstruction of the nose, and increases the airway resistance and work of breathing. On the other hand, orogastric route causes to mucosal trauma and vagal stimulation (apnea and bradycardia). There are only two small trials comparing oro vs nasogastric route in preterm infants. There is no clear evidence on which of the two routes should be preferable in the clinical setting.

In NICU, there are two feeding methods to use gavage feeding: intemittant (bolus) or continuous infusion. Continuous feeding may improve energy efficiency, contibute to improved growth and decrease the feeding intolerance and the risk of hypoxic-ischemic intestinal damage. However, this technique may increase GER, and decrease fat delivery to the infant. If the continuous method is used, three strategies can improve fat delivery. First, the syringe should be oriented with tip upright allowing fat to rise to the top and be delivered first. Second, length of feeding tube should be shortened, preventing loss of fat on tubing surfaces. Third, the syringe should be emptied completely at the end of the infusion. This practice will prevent the loss of fat. Continuous feeds may be useful in infants who have not tolerated bolus feedings. Intermittant bolus feeding is a more physiological approach to term infants and positively affects the cyclic release of GIS hormones in terms. Intermittent bolus feeding may be used usually every 2 hours for babies weighing less than 1.5 kg and 3 hours for those weighing 1.5 kg and above. Intermittant bolus method may increase feeding intolerance and causes limited growth. It may also decrease cerebral perfusion in preterm infants. In new Cochrane meta-analysis (Seven clinical trials; 511 patients) there is no difference in time to achieve full feedings and incidence of NEC is similar. We must keep in mind that continuous feeding might be advantageous in the establishment of faster full enteral feeding, and decreasing the risk of hypoxic-ischemic gut damage in preterm neonates in critical condition, especially SGA infants, by limiting their gastrointestinal oxygen requirement. In VLBW infants, continuous feeding seems to be better than intermittent feeding with regard to gastrointestinal tolerance and growth. In the smallest infants, it was more evident in birth weight ≤850 g. Continuous feeds may be useful in infants who have not tolerated bolus feedings.

Intermittent bolus feeds may be administered using a syringe to gently push milk into the infant's stomach (push feed) or into a syringe attached to the tube and allowed to drip in by gravity (gravity feed). Some centers use the push method, some centers use the other one. In one small cross-over study, Symon A and Cunningham S compared nasogastric feeding methods (push versus gravity). They found a higher respiratory rate in the push method. In terms of achievement of full oral feeds, growth rate, discharge time or the incidence of necrotizing enterocolitis, there is no significant difference between the two methods. To date, there is no sufficient evidence to recommend one of these methods.

The enteral tube feeding is the most common practice in NICU. Unfortunately, almost all of the different practices associated with enteral feeding are not evidence-based. Large, well-designed, randomized controlled studies are needed to provide the clear scientific evidence about feeding practices in preterm infants.

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Cell-Based Therapies: Beginning of a New Era?

Muhammad Aslam, MD

Recent advances in medicine have resulted in improved survival for our tiniest and most vulnerable preterm infants born at the edge of viability. Unfortunately, this increasing survival is at the expense of an increase in morbidities such as chronic lung disease (aka bronchopulmonary dysplasia, BPD), neurological impairment, and behavioral issues. BPD was first described by Northway almost four decades back as a respiratory disease of now near term infants who require oxygen and/or mechanical ventilation. Since then, the disease itself has been modified which is now referred to as new BPD and is clinically defined as oxygen requirement of >21% for at least >28 days as assessed at 36 weeks corrected gestational age. Despite advancements in care, the disease itself has not changed with limited understanding and available therapies. At present, approximately 1 in 3 infants born less than 30 weeks gestational age develop BPD, varying from mild to severe.

Alexander Maximow first used the term "stem cell" to describe hematopoiesis where all blood cells develop from a single precursor cell. Since then considerable interest has developed in the stem cell field and their utilization for therapeutic purposes. Recent years have seen an increase in hype about stem cell-based therapies for diseases like BPD. Although animal research has shown promising results with stem cell use in various disease models, data are lacking on their effectiveness in humans. Similarly, several preclinical and clinical papers have described a potential role of stem cells in lung diseases and BPD. Stem cells can be harvested from amniotic fluid, embryo, bone, blood, and umbilical cord.

Challenge in the stem cell field is that the biggest advantage of a stem cell is also its biggest disadvantage. The word stem cell is self-explanatory in the sense that a single stem cell has a potential for self-propagation and inadvertent growth leading to tumor formation. This has limited investigators in making final dossier of stem cells to be used as a therapeutic modality. Work in animal models utilizing stem cell conditioned media/secretome which is free of cells has shown promising results like stem cells themselves in prevention and/or reversal of BPD. Interest of pharmaceutical companies in this exciting field is paramount but at present only outside the United States given federal regulations. In fact, the very first human trial of utilization of stem cells for BPD treatment has been conducted in Korea approved by the Korean FDA. The trial drug, Pneumostem, is comprised of human umbilical cord-derived mesenchymal stem cells manufactured by Medipost Co Ltd. and the trial was registered at clinicaltrials.gov. Although this trial has been completed in 2012, the results are still not released despite the fact that phase 2 trial has been in progress already.

Given so much uncertainty about the proper dose and mode of delivery of stem cells and/or their secretome and reports of stem cell-based therapies outside US, the National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health convened the Cell Therapy for Lung Disease Working Group in 2012 to review and formulate recommendations for future research directions. The group concluded that cell-based therapies are a new pillar of drug development but further bench work is required before these therapies can be pioneered to bedside approaches. Work on questions like cell origin, mode of delivery, cellular vs. cell-free dossier, mechanistic assessments, side effect profile, etc. should run parallel to the standard clinical trials to maximize efficacy and minimize side effects.

In conclusion, cell-based therapies are a new era of treatment for BPD and other lung diseases which currently lack effective treatment, but an aggressive bench and bench-to-bedside approach is needed to make this a reality.

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WWBS: Fact or Fiction?

David G. Oelberg, MD

Have you heard of the acronym WWBS (aka wimpy white boy syndrome, wimpy white male syndrome, little white boy syndrome, lazy white boy syndrome)? If you haven't, ask the parents of the white boys in your intermediate-care nursery? They all seem to know about it. And though I used to think that the phrase was parochial to the Eastern seaboard, presence of the phrase on lay websites from California to New York suggests that the phrase is now ubiquitous throughout the United States.

What is WWBS? The term describes a neonatal white boy with adjusted gestational age of 35-40 weeks who is failing to achieve the developmental landmarks of weaning to an open crib and/or taking all of his oral feeds as expected. While the diagnosis is not listed among ICD codes, and while the diagnostic criteria may differ from nursery to nursery (some include apnea in the syndrome), everyone agrees that it is a white boy failing to make the transition from nursery to home for reasons unexplained by defining medical diagnoses — other than hypothermia or feeding delay.

Where does the term WWBS come from? My only sources of information that date back to 2007 are the lay websites or blogs for parents of premature infants. According to PubMed the closest reference to "wimpy white boy syndrome" is "jimpy white boy syndrome" also known as Pelizaeus Merzbacher disease — an X-linked, recessive disorder of CNS myelination. I don't think they are related. Is it recognized for Caucasian boys outside the United States? I could not find reference to it in the Canadian, Latin American, or Western European lay presses, but I suspect the phenomenon — if real — endures by some other name.

Is it real? It has been my experience that clinical rounds in a busy, intermediate-level nursery generally confirm the presence of at least one wimpy white boy most mornings. But is that because of my ongoing biases, or is that because white male newborns are predisposed to wimpiness? Review of the medical literature is not very supportive of the latter. It is clearly documented that survival of premature males lags behind that of premature females, and that survival of white males is probably less than that of non-white males.[1] But the frailty of white males ends there. Though neurodevelopmental, cognitive, and functional outcomes of premature females also exceed those of premature males, premature white boys fair better than premature black boys in most studies.[2-4] Among term or near-term newborns, evidence for sexual or racial disparities in neurologic development or behavioral functioning is inconsistent,[5,6] and one attempt to prove that premature, white males are behaviorally less competent than peers was unsuccessful.[7] In short, apart from survival statistics, there are no observational surveys confirming the existence of WWBS.

Does WWBS exist because of the varied approaches utilized for transitioning to home from nurseries, or does it exist because of valid racial and sexual neurodevelopmental disparities? If interested in testing the hypothesis that WWBS exists, how should one approach the investigation? An observational approach would require staff adherence to strictly defined, standardized strategies for transitioning from gastric to oral feedings and from isolette to open crib environments. Through control of variances otherwise introduced by staff biases and varied therapeutic approaches to these transitions, investigators might be able to demonstrate sexual and racial disparities regarding progression home if they truly exist. And if there are demonstrated differences, do they occur because white boys on average are whimpier than their peers? Or do they occur because there are white, male outliers with delays that skew the distribution of white boy accomplishments but that do not change the average white male scores? The latter could explain prior failures to demonstrate significant racial and male disparities.

Should we strike the term WWBS from our nursery vocabulary because of its discriminatory or disparaging connotations? Valid arguments might be raised from legal, ethical, marketing, and even scientific perspectives, but I have yet to meet a parent who has expressed offense or disgust at the term. In fact, most white parents find the term somewhat endearing because it highlights their roles in the ongoing provision of extra nurturing and patience.

In closing, systematic investigations of WWBS might be of value in understanding the varied clinical courses observed in premature newborns transitioning from nursery to home. But even more important than probing the existence of WWBS might be the identification of the most cost-effective strategies for transitioning home safely. Clinical approaches utilized for weaning to open crib and advancing to oral feeds vary from nursery to nursery and practitioner to practitioner; and as

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News

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One Device Better Than Two

Masimo announced that its SET Measure-through Motion and Low Perfusion pulse oximetry has now been integrated into ACUTRONIC Medical System AG's fabian HFO Neonatal Critical Care Ventilator for improved patient outcomes. The fabian HFO, the world's first dedicated Neonatal Ventilator to offer Masimo SET pulse oximetry, provides continuous display of newborn oxygenation status. Instead of using two separate devices to collect ventilation and oxygenation patient data, clinicians now simply attach the pulse oximetry sensor via USB interface to the fabian HFO to display oxygenation, perfusion index and pulse rate values on the ventilator's color touchscreen. This combined technology platform is expected to optimize patient assessments and improve workflow, allowing clinicians to spend more valuable time tending to patients. Masimo said its SET pulse oximetry has been shown to virtually eliminate false alarms and increase a clinician's ability to detect life-threatening events, helping to substantially contribute to improved patient outcomes and patient safety. The clinical accuracy of Masimo SET pulse oximetry has also been shown to help clinicians significantly reduce retinopathy of prematurity (ROP), screen for critical congenital heart disease in newborns, reduce oxygen overdose and medical errors, and save lives in post-surgical floors, recovery, labor and delivery rooms, and ICUs.

Birth Tool Found in a Dream

A tool to help babies stuck in the birth canal is earning rave reviews from the World Health Organization. Jorge Odón, an Argentine car mechanic, came up with the idea from a dream after watching a YouTube video about extracting a lost cork from a wine bottle. Odón built his first prototype in his kitchen, using a glass jar for a womb, his daughter's doll for the trapped baby, and a fabric bag and sleeve sewn by his wife as his lifesaving device. A US medical technology company has just licensed it for production. With the Odón Device, an attendant slips a plastic bag inside a lubricated plastic sleeve around the head, inflates it to grip the head and pulls the bag until the baby emerges. Doctors say it has enormous potential to save babies in poor countries, and perhaps to reduce cesarean section births in rich ones. About 10 percent of the 137 million births worldwide each year have potentially serious complications. About 5.6 million babies are stillborn or die quickly, and about 260,000 women die in childbirth. Obstructed labor, which can occur when a baby's head is too large or an exhausted mother's contractions stop, is a major factor. The current options in those cases are forceps

— large, rounded pliers — or suction cups attached to the baby's scalp. In untrained hands, either can cause hemorrhages, crush the baby's head or twist its spine. Although more testing is planned on the Odón Device, doctors said it appeared to be safe for midwives with minimal training to use. Along the way, it has won research grants from the United States Agency for International Development and from Grand Challenges Canada. The device will be manufactured by Becton, Dickinson and Company, or BD, of Franklin Lakes, N.J., which is better known for making syringes. The W.H.O. will now oversee tests on 100 more women in normal labor in China, India and South Africa, and then on 170 women in obstructed labor. Information is from an article that appeared in the New York Times. Copyright The New York Times.

Saintly Donation

Marques Colston is noted for creating noise with his amazing catches across the middle of the football field, but the New Orleans Saints wide receiver is quietly helping New Orleans neonates hang on to something more important than a football — their lives. Colston donated about $100,000 to Children's Hospital to fund the purchase of a NeoRay Digital Imaging System for the hospital's Neonatal Intensive Care Unit. The highly portable X-ray system is specially designed for use with newborns. It may be easily moved from incubator to incubator and allows for a drastic reduction in radiation exposure; a critical need in the early days of life. Children's Hospital is a 247-bed, not-for-profit regional medical center offering pediatric care to children from birth to 21 years. Children's Hospital recorded 200,834 patient visits in 2012, with children coming from all 64 parishes in Louisiana, 37 states and 6 foreign countries. In all, 60,557 children received care from the hospital in 2012.

Study Goes Nuts

Pregnant women who eat more peanuts and tree nuts during pregnancy might be less likely to bear nut-allergic children, a new study suggests. Pregnant women who eat more peanuts and tree nuts during pregnancy might be less likely to bear nut-allergic children, a new study suggests. The research, published in the journal JAMA Pediatrics, supports the current consensus among medical professionals that delaying the introduction of nuts, milk, fish, shellfish, eggs and other highly allergenic foods in young children doesn't prevent the development of food allergies, said Michael C. Young, associate clinical professor of pediatrics at Harvard Medical School, and a senior author of the study. The findings inversely link a pregnant mother's consumption of peanuts or tree nuts with the onset of nut allergies in her child. The more nuts the mother ate while pregnant, or within a year before or after pregnancy, the lower the risk that the child would go on to develop nut allergies, Dr Young said. The study doesn't demonstrate a causal relationship between a pregnant mother's diet and the onset of nut allergies in her offspring, he said. The researchers stopped short of advising pregnant women to eat more nuts. Further, interventional studies — in which researchers would separate participating pregnant women into groups and prescribe their diets, rather than simply track their consumption — are required before they can make such a recommendation. Researchers analyzed data from 8,205 children born between Jan. 1, 1990 and Dec. 31, 1994 to mothers who had reported their diets at or around the time of pregnancy. Of the children they tracked, 140 had developed a peanut or tree nut allergy by 2009. All self-reported cases of physician-diagnosed nut allergies were reviewed independently by two pediatricians, according to the study. The prevalence of childhood peanut allergy in the U.S. has become an "epidemic" in recent years, Dr Young said. The rate of 1.4% in 2010 is more than triple the rate of 0.4% in 1997, according to the study. Information is from an article that appeared in the Connect by Lindsay Gellman. Copyright Connect.

Costs Vary in NY Hospitals

Just how expensive is your hospital? In New York, the answer may lie in a trove of hospital cost data newly posted online by the State Health Department. As part of an effort to make health care pricing more transparent, the state is naming hospitals and listing their median charges and costs for 1,400 conditions and procedures from 2009 to 2011. In 2011, prices ranged from the $8 bill at Benedictine Hospital in Kingston, N.Y., for treating a case of gastritis (cost: $2), to a $2.8 million charge for a blood disorder case at University Hospital of Brooklyn that cost it $918,462. Hospital trade groups, who opposed the release of the database, say the figures will only confuse consumers, who rarely pay the sticker price for hospital care, especially if they have insurance. The hospitals also argue that cost figures, though based on reports to the government by the hospitals themselves, cannot be reliably compared because the state did not edit them for deaths, transfers and aberrations. Among the most common hospital admissions each year are cases of childbirth and the routine medical care of healthy newborns. There, too, the database shows extreme and unpredictable variations in cost, markups and charges. A. O. Fox again seems like a bargain, the rare hospital that charged less, on average, for its 140 vaginal deliveries with minor severity than its reported median cost — $1,998 versus $2,603. At Westchester Medical Center in Valhalla, on the other hand, 183 deliveries coded the same way cost $6,692 and were charged at $22,413, among the most expensive such cases in the state. Maimonides Medical Center in Brooklyn spent $1,675 per case of newborn care and charged $5,400, while at Montefiore Medical Center in the Bronx, the cost was $2,586 and the price $10,950. Information is from an article that appeared in the New York Times. Copyright The New York Times.

Home Births Linked to Complications

The small but rapidly increasing number of women who choose to give birth at home may want to consider new research indicating that home births are linked to increased neonatal complications, including seizures. Researchers from Oregon Health & Science University and University of California at San Francisco, which studied babies born in 2008, found that home birth nearly doubled the risk for Apgar scores of four or lower on a 10-point scale; seven is considered normal. The scores evaluate newborns based on appearance, pulse, grimace, activity and respiration. Although educated and married white women over age 35 were most likely to choose home birth, the researchers controlled for age, race, gestational age at birth, among other factors. The home birth mothers in the study were less likely than others to experience induced labor or an assisted delivery, and researchers found that home births attended by certified nurse-midwives yielded complication rates not much different from hospital births. Nurse-midwives presided over more than a quarter of these home births.

Reality of Resuscitation Times

A new study suggests many newborns are not being managed within resuscitation guidelines and that the recommended intervals may be too short. The study — through a team of researchers in Dublin, Ireland, including at the Department of Neonatology, National Maternity Hospital — said that most

newborns in the study "were not managed within the time frame recommended in resuscitation guidelines. The recommended 30- and 60-second intervals may be too short." Researchers were looking to determine whether resuscitation teams were able to adhere to the recommended algorithm for newborn resuscitation. Video recordings were made of delivery room resuscitations of 194 high-risk neonates (gestational age 27-34 weeks; mean, 29 weeks) at 2 hospitals. Staff in these hospitals were trained to follow the NRP algorithms in the delivery room and were experienced in neonatal resuscitation. Interventions in newborn resuscitation, known as "initial steps," involve placing the newborn who requires assistance on a radiant warmer, then towel-drying or placing the newborn's body in a polyethylene bag; positioning the airway (and clearing the airway if needed); assessing the infant's respiratory effort and heart rate; and stimulating the infant to breathe, if necessary. These steps are intended to be accomplished by 30 seconds of age, and the clock starts ticking at the time of birth, not the time that the infant is placed on a radiant warmer. According to the study, called Timing of Interventions in the Delivery Room: Does Reality Compare With Neonatal Resuscitation Guidelines, "the median time taken to perform all tasks was greater than that recommended in the guidelines."

'Terms' of Endearment

Concerned by trends to induce labor or schedule cesarean deliveries earlier than 39 weeks gestation for a single fetus, the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine has issued four new definitions of 'term' deliveries to clarify matters for women and doctors. The new definitions are based on the duration of pregnancy calculated from the first day of a woman's last menstrual period, a known date of conception, or an ultrasound measurement of the fetus during the first 13 weeks of pregnancy: early term, between 37 weeks, 0 days and 38 weeks, 6 days; full term, between 39 weeks, 0 days and 40 weeks, 6 days; late term, between 41 weeks, 0 days and 41 weeks, 6 days; post term, 42 weeks, 0 days and beyond. The college hopes this terminology change makes it clear to both patients and doctors that newborn outcomes are not uniform even after 37 weeks. The college advocates patience: observing mother and fetus weekly, and allowing nature to take its course when there is no reason to intervene. If it is important to schedule a C-section or to induce labor in an otherwise healthy pregnancy, "after 39 weeks is appropriate," the college said.

Risk of Infections Elevated

A study suggests increased infections could be created with longer duration PICC placement. According to study author Dr Aaron M. Milstone of Johns Hopkins University, peripherally inserted central catheters (PICCs) are often used in the neonatal intensive care unit (NICU) to aid in the delivery of medications and nutrients to neonates. However, PICCs can also be the culprit of central line associated blood stream infections (CLABSIs). Dr Milstone said the multicenter, retrospective cohort study looked at the temporal relationship between PICC insertion and development of CLABSI. Through this analysis, researchers found an elevated risk of CLABSI when PICC placement went beyond 7 days as opposed to shorter durations. This increase in risk persisted for 2 weeks after placement, and then remained elevated, but stable for the duration of the PICC. While Gram-positive infections were the most common etiology of CLABSIs in PICCs, an increase in Gram-negative infections was noted when PICC duration exceeded 50 days. This study's multicenter design limited consistency in data collection and reporting across included institutions. This research suggests ongoing attention to necessity of PICCs, and to further quality improvement measures to decrease occurrence of CLABSIs. Given the noted incidence of CLABSIs with PICC dwelling time, the judicious placement and removal of PICCs could be warranted to prevent infections.

Later Not Necessarily Better

A study suggests that a shift in practice away from elective late preterm delivery to early term deliveries has shown little impact on neonatal outcomes such as intensive care length of stay, neonatal morbidity, or mortality in a population with major congenital heart disease. Researchers at Columbia University Medical Center and Morgan Stanley Children's Hospital, both in New York, sought to evaluate the effect of a change in delivery practice that was introduced following the 2009 publication of a study showing improved outcomes in infants delivered after 39 weeks. Medical records were reviewed for infants with critical congenital heart disease and compared outcomes in 878 infants born at a single tertiary center during 2004-2008 to outcomes in 124 infants born in 2010, after the change in practice had been implemented. There was a significant increase in the mean gestational age (37.8 weeks vs. 38.4 weeks, respectively; P less than .01) and in mean birth weight (2,975 grams vs. 3,134 grams; P less than .01). However there were no significant differences between 2004-2008 and 2010 data in 5-minute APGAR scores (8.5 vs. 8.6; P = .11), median length of stay (14 days [1-197] vs. 16 days [1-144]; P = .18) and neonatal mortality (6% vs. 11%; P = .07), according to data presented at the International Society of Ultrasound in Obstetrics and Gynecology world

congress. Information is from an article that appeared in the News Digital Network. Copyright News Digital Network.

Neonatal Webcam Gets Thumbs Up

Parents are praising a webcam system for letting them monitor their babies' progress at the Anya Marie Jackson Neonatal Intensive Care Unit at Aspirus Wausau Hospital. The webcam system, called NICVIEW, includes cameras in each room of the intensive care unit that can be positioned over each baby. Families are given secure, encrypted login information that they can pass along to friends and family members who can log in any time to monitor a baby's progress. There is no charge for the service. With this new system, parents, friends or family members can log in from a computer, a tablet or a smartphone and see the baby and what's happening inside the NICU. The NICVIEW system cost $51,990 and funding was made possible through the 2013 Aspirus Women's Golf Classic. Nearly 300 golfers, caddies and volunteers partnered with Aspirus and nearly 100 businesses and community members to help make the purchase possible.

Exercise Could Affect Babies' Brains

A study of expectant mothers and their newborns says physically active pregnant women increase the development of their unborn child's brain. Researchers at the University of Montreal in Canada recruited a group of local women who were in their first trimester of pregnancy. The women were randomized either to begin an exercise program, commencing in their second trimester, or to remain sedentary. The women in the exercise group were asked to work out for at least 20 minutes, three times a week, at a moderate intensity, equivalent to about a six or so on a scale of exertion from one to 10. Most of the women walked or jogged. Every month, for the remainder of each woman's pregnancy, she would visit the university's exercise lab, so researchers could monitor her fitness. All of the volunteers, including those in the non-exercise group, also maintained daily activity logs. After about six months and following the dictates of nature, the women gave birth. All had healthy boys or girls — which the scientists gently requested that the mothers almost immediately bring in for testing. Within 12 days of birth, in fact, each of the newborns accompanied his or her mother to the lab. There, each baby was fitted with an adorable little cap containing electrodes that monitor electrical activity in the brain, settled in his or her mother's lap, and soothed to sleep. Researchers then started a sound loop featuring a variety of low, soft sounds that recurred frequently, interspersed occasionally with more jarring, unfamiliar noises, while the baby's brain activity was recorded. The study found brainwave activity soared in response to the novel sounds among the children born to mothers who had remained sedentary during pregnancy. But it was noticeably blunted in the babies whose mothers had exercised. Information is from an article that appeared in the New York Times. Copyright The New York Times.

Drinking Study Upsets Group

A Danish study on the behavioral outcomes of children whose mothers consumed alcohol during pregnancy is being called potentially harmful by Fetal Alcohol Syndrome (FAS) experts because of the media coverage it has generated. "It's deeply concerning," said Dr Kenneth Lyons Jones, who is president of MotherToBaby, a service of the international non-profit Organization of Teratology Information Specialists, and professor of pediatrics at the University of California, San Diego. The research causing such concern among experts over misinterpretation is a series of studies out of the University of Copenhagen. "The take-home message of this study should in no way be to encourage drinking in pregnancy as a means to better mental health for children," Dr Jones said. Janni Niclasen, a psychologist, surveyed approximately 37,000 Danish women who reported on drinking habits during pregnancy. The study results showed that women who drank as much as one glass of wine per week had children with better emotional and behavioral outcomes by age seven compared to children of mothers who claimed to not drink at all. However, the author also points out that mothers who reported drinking tended to be more educated and have other potentially healthier characteristics overall. In addition, the author points out that the timing of the alcohol exposure during the surveyed pregnancies, which can play an important role in how the fetus is affected, was ignored. According to a statement from MotherToBaby, the study does not show that drinking caused mothers to have children with fewer behavioral concerns — rather that mothers who reported drinking were very different from mothers who did not in multiple ways. These differences in family and home environment, along with the way that alcohol exposure and child health were measured could easily mask any associations with low-level alcohol.

Childhood Asthma Link Established

Researchers have found that neonatal hyperbilirubinemia is associated with an increased risk for childhood asthma. By assessing data from the US Collaborative Perinatal Project, which took place between 1959 and 1965, the team was able to separate the effects of hyperbilirubinemia on asthma risk from those of phototherapy, which has also previously been linked to childhood asthma and was not yet in clinical use at the time of the project. The analysis included 28,807 term infants who were followed up to the age of 7 years, during which time 5.3% were diagnosed with asthma, reports the team, led by Jun Zhang (Xinhua Hospital, Shanghai, China). They found that, after adjustment for confounders, the prevalence of asthma significantly correlated with both the maximum total serum bilirubin level (measured around 48 hours postpartum and 24 hours later, and 4-5 days later if >10 mg/dL) and the level 48 hours after birth. The highest prevalence of asthma was observed in the 2.4% of children with maximum bilirubin levels of greater than 15 mg/dL, at 8.0%. This equated to a 61% increased odds for asthma compared with patients with a maximum bilirubin level of 3 mg/dL or less. Noting that the magnitude of the relationship between neonatal hyperbilirubinemia and asthma is similar to that in phototherapy-era studies, the researchers say the study "indicates that jaundice, not phototherapy, is associated with asthma." Information is from medwireNews with permission from Springer Healthcare Ltd.

Helpful Bacteria Can Also Harm

Cells that allow helpful bacteria to safely colonize the intestines of newborn infants also suppress their immune systems to make them more vulnerable to infections, according to new research in Nature. The study could prompt a major shift in how medicine views the threat of neonatal infections and how researchers go about looking for new strategies to stop it, said scientists at Cincinnati Children's Hospital Medical Center who conducted the research. Leading up to this study, the prevailing view has been that newborn infants are susceptible to infection because their immune system cells are immature or underdeveloped. The study suggests this is caused by active immune suppression during this developmental period, as opposed to the immaturity

of immune cells. The suppressive cells in this case are CD71+ precursors of mature red blood cells. The researchers found CD71+ precursor cells are enriched in newborn mice (and in human umbilical cord blood) to prevent an over reactive immune response as infants adapt to their new microbe-filled world. CD71+ cells express an enzyme called arginase-2 that is essential to suppress immune cells. Researchers said this process plays a vital role in infants' developing intestines by preventing an onslaught of inflammation in response to colonizing bacteria that help digestion and related functions. Researchers used a series of laboratory tests in human blood cells and mouse models to show temporary immune suppression in newborns extends beyond the intestines to also affect other parts of the body.

Hospital Doesn't Drink Decaf

Caffeine has been shown to help reduce the risk of neurological (brain) damage in premature infants, help infants come off ventilators (breathing machines) sooner, as well as help infants who have stopped breathing (apnea), according to research from the Cone Health Women's Hospital in North Carolina. The team of pharmacists at Women's Hospital has researched and published a report providing the range of caffeine levels that are appropriate for each condition. It found different levels and forms of caffeine must be administered for each situation. This research provides the neonatal care team with a base line to help individualize the caffeine dosage each infant needs to receive the optimal benefits. This is just one research study done in collaboration with the Neonatal Pharmacotherapy Education Program. The goal is to advance the neonatal care that premature infants and full-term infants who have experienced certain complications at birth receive at Women's Hospital. At Women's Hospital, the dosing of antibiotics is individualized from the first dose because several studies performed by the neonatal pharmacists and physicians at Women's Hospital showed that the dosing guidelines from dosing handbooks were not reliable at achieving blood levels needed for effective treatment, while also avoiding damage to the kidneys and ears. Instead, blood levels of the antibiotic are drawn twice after the first dose, and the pharmacists use special calculations to make sure the most effective and safe levels are achieved to help infants get better and home to their families as quickly as possible.

Breakthrough in Neonatal Diabetes

Researchers at University of Exeter Medical School in Britain say they have discovered two new genetic causes of neonatal diabetes, a rare disease that affects approximately 1 in 100,000 births. Neonatal diabetes is caused by a change in a gene which affects insulin production. This means that levels of blood glucose (sugar) in the body rises dangerously high. The team discovered that mutations in two specific genes which are important for development of the pancreas can cause the disease. The study focused on 147 young people with neonatal diabetes. Following a systematic screen, 110 patients received a genetic diagnosis. For the remaining 37 patients, mutations in genes important for human pancreatic development were screened. Mutations were found in 11 patients, four of which were in one of two genes not previously known to cause neonatal diabetes — NKX2-2 and MNX1. The genetic discovery is critical to the advancement of knowledge on how insulin-producing beta cells are formed in the pancreas. This could one day lead to a cure for neonatal diabetes, said the paper published in the journal Cell Metabolism.

Distance From Hospital a Risk

Infants with hypoplastic left heart syndrome (HLHS) born far from a hospital providing neonatal cardiac surgery for the condition have increased neonatal mortality, with most deaths occurring before surgery, according to a new study. Researchers led by Texas Children's Hospital and Baylor College of Medicine (BCM), published online in the journal, Circulation, also concluded that efforts to improve prenatal diagnosis of HLHS and subsequent delivery near a large volume cardiac surgical center may significantly improve neonatal HLHS survival. HLHS occurs when the fetus's left side of the heart does not develop normally, and is present in approximately 1 in 6,000 live births. Of the more than 3.4 million births during the study period, 463 infants with HLHS were assessed. Mothers delivering farther from a cardiac surgical center were less educated and more often lived in a poverty-stricken area. Additionally, 39 percent of newborns studied were prenatally diagnosed with HLHS and delivered significantly closer to a cardiac surgical center. Forty percent of newborns with HLHS died that were born more than 90 minutes from a cardiac surgical center, compared to 21 percent of those born within 10 minutes of a surgical center. The percentage of patients that died after the first surgery for HLHS was two to four times higher in low volume surgical centers than in the highest volume centers. Overall, in the latest years of the study, newborns with a prenatal diagnosis, born less than 10 minutes from a cardiac surgical center, and cared for at a large volume cardiac surgical center, had a neonatal mortality of 6 percent. For those born in the same era without a prenatal diagnosis, more than10 miles from a cardiac surgical center, and cared for at a low volume cardiac surgical center, 28-day mortality was 29 percent.

Plan Set for Infant Mortality

The health department of India has developed a plan to reduce infant mortality in the country by implementing certain clinical guidelines and quality standards that are expected to change the manner in which neonatal care is practised in major hospitals. The department teamed with Access International, a not-for-profit organization that works with governments and provides research and training inputs to improve health care service delivery and processes. Four working groups, including pediatricians, neonatologists, obstetricians, and infection-control experts from major tertiary care hospitals in the country, have been working on the basic premise — based on a study by the Indian Academy of Pediatrics (IAP) — that the major causes of infant deaths in the area of Kerala were prematurity (34.6 percent), congenital anomalies (28 percent), sepsis (9.3 percent), and birth asphyxia (8 percent). The IAP study had reported that 75 percent of the infant deaths occurred during the neonatal period, and that of the total neonatal deaths, 59 percent of the deaths occurred during the first week of life. The groups have now formulated 13 quality statements relating to antenatal, intra-partum and neonatal interventions, the practice of which is expected to make a significant dent in neonatal mortality. The majority of deliveries in the area continue to take place in the private sector, and any quality improvement program aimed at bringing down the IMR would have to include the private sector, the IAP has pointed out.

Hospital Adds Cooling in Transport

Texas Children's Hospital is now the only pediatric hospital in Texas to offer active and regulated whole body cooling for infants who are oxygen-deprived at birth during ambulance transport to the hospital's level IV neonatal intensive care unit

(NICU). Previously, oxygen-deprived infants would be passively cooled prior to and during transport, where all heat sources were turned off, meaning many infants would be under-cooled or overcooled. Whole body cooling treatments are administered within six hours of birth, last for 72 hours and bring a baby's temperature down to 33.5 degrees Celsius (92.3 Fahrenheit) to allow brain cells that would have otherwise died or been severely damaged, to survive. Texas Children's Newborn Center, together with the hospital's new Pavilion for Women, houses the nation's largest NICU and is one of only two hospitals in the greater Houston area to offer whole body cooling treatments and the only pediatric hospital in Texas to offer safe and regulated active whole body cooling during ambulance transport using specialized cooling equipment.

Computer Hears Babies Cry

Researchers at Brown University and Women and Infants Hospital in Providence have devised a computer program to help analyze a baby's cries. They hope to soon make it available to researchers world-wide looking to analyze crying patterns that can't always be detected by the human ear. The computer program breaks down cries into 12.5-millisecond frames and measures the pitch and volume, among other parameters. In total, it can evaluate 80 different parameters, which could help detect risk for conditions affecting a newborn baby's health. Because a cry is controlled by cranial nerves, it can be a window into the brain. While researchers haven't reached the stage where they can link cry characteristics with specific conditions, they've found that, on a group level, an infant's nervous system and therefore cry can be affected by prenatal exposure to alcohol, birth injuries, and even related to later diagnoses of autism. Researchers aren't at the stage where cries can pinpoint specific illness, although that is the ultimate goal. Today, a baby's cry can be tapped for information on pain and the nervous system. Information is from an article that appeared in the Wall Street Journal. Copyright the Wall Street Journal.

Feeding Practices…continued from page 6

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Invictus Medical: Pursuing a New Standard of Care

Invictus Medical, a Texas-based medical technology company, currently is in the latter stages of developing an award-winning, patented cranial support technology that could become a new standard of care in neonatal treatment.

The company's technology interest focuses on combating deformational plagiocephaly (DP), a cranial deformity exhibited in infants resulting from repeated external pressure to one area of the head. In addition to being a cosmetic issue, according to a study published in *Pediatrics* in 2013, DP has been associated with heightened risk for developmental delays in infants and toddlers. An estimated 1.2 million US newborns are at risk of DP, with the condition annually affecting approximately 20 to 30 percent of infants. Invictus anticipates its product becoming a standard of care in preventing DP, filling an unmet need where current prevention methods are inadequate and current correction methods do not eliminate developmental issues.

Invictus will begin its patient safety study early this year and anticipates commercializing its first product in 2014. The company's board of directors (five members, including three outside directors) and executive leadership team possess deep experience in governance, capital investment, research and technology, executive management, business and market development, and product commercialization. The company also has enlisted commercialization partners with successful track records introducing innovative medical devices into the market.

Historically, the most prevalent way to address the deformational plagiocephaly issue has been through the use of cranial orthotics; however, the cranial orthotic therapy currently available is corrective instead of preventative, can be costly, and may require multiple devices.

The Invictus Medical infant cranial protection device is designed as a preventative option to significantly reduce cranial complications. As a cranial pressure protector, this mobile and unobtrusive device contains a proprietary gel solution specifically designed to dramatically increase surface area contact and greatly reduce peak pressure.

Invictus Medical anticipates initially marketing its product to pediatric hospitals and NICUs. The company anticipates submitting its 510k application to the FDA in the first half of 2014 and estimates launching its first product within the year. Invictus closed its seed round of funding in 2013 at 100 percent of target, has raised more than $2 million to date, and began its Series A funding in the first quarter of 2014.

Invictus Medical can be contacted at 210-201-3304 or at invictusmed.com.

Experiences Using Crib Notes to Improve Patient Care

In this feature, Neonatal Intensive Care interviews clinicians and healthcare providers about the actual application of specific products and therapies. Participating in the interview from Children's Hospital of New Jersey is: Ketan Kansagra, MD Attending Neonatologist.

Neonatal Intensive Care: How large is your unit and what level?
Ketan Kansagra: We have a 54-bed NICU that is NJ's only ECMO center.

NIC: How long have you had Crib Notes in your unit?
KK: We've been using Crib Notes for over 3 years.

NIC: What method of documentation did you use before Crib Notes?
KK: We used the Mail Merge feature of Microsoft Word/Excel and printed the notes on hospital progress note paper.

NIC: Does the system "talk" to other systems (lab, etc.) within your hospital?
KK: Crib Notes receives information via HL7 transactions, ADT, lab, and radiology from other systems, and populates appropriate areas in the EMR. Crib Notes has additional capabilities of interfacing data from vital signs monitors and our GE OB system, but we haven't implemented those features yet.

NIC: How long did the system implementation take? How long was the go-live process?
KK: Our organization signed the contract on May 24, 2010 and we went live December 6-7, 2010, so it took approximately six months to get from contract to go-live. We went with a "big bang" approach to the go-live, and the process was pretty painless. Within a day, the staff was comfortable using the system. The Crib Notes team was here for most of a week to assist in the transition and the process was very smooth.

NIC: How has using Crib Notes impacted patient care in your unit?
KK: The overall impact has been very positive. We knew that implementing an EMR would change our workflow, and that happened immediately, and was for the better. We have much more information about our patients when we write our notes and our documentation is much better organized than it was in the past. Our Discharge Summaries go out in real time, and have all the appropriate information. And things just don't fall through the cracks. In terms of the clinical details of our care, we had been very happy with the day-to-day care that we provided to our patients in the past, and Crib Notes supported our approaches.

NIC: How have accrediting agencies (JCAHO, etc.) responded to Crib Notes?
KK: We passed with flying colors! The surveyors were very pleased with the ease with which we can view the multiple disciplines' documentation. Although the hospital subsequently implemented an enterprise system, Crib Notes was recognized as the best solution for the NICU and we weren't requird to switch over.

NIC: Uptime is a critical component of computerized charting. Has the system uptime met your expectations?
KK: Yes, and this hasn't been a problem. Downtimes are an occasional issue for the hospital infrastructure, and very rarely due to a Crib Notes problem. When something comes up, the Crib Notes team is readily available and deals with it very quickly.

NIC: What advice would you give units considering Crib Notes as a documentation solution?
KK: Go for it. It's the gold standard for what this type of system should be in the NICU. In considering other systems (which I wouldn't!) I would strongly recommend using a system that integrates both the nursing and clinician charting tools like Crib Notes does because the data entry of the nurses leads to an astounding array of robust information, both clinical and analytical. In implementing any EHR solution, you need to put a team together that works (relatively) harmoniously, understands technology brings process changes, and can handle working with non-clinical teams. Finally, do not be shy to question the vendor why things are programmed a certain way. For Crib Notes, the system has been designed based on a lot of NICU clinical experience and day-to-day bedside use of the system. The Crib Notes team can intelligently explain the "why" and help understand what the impact would be of alternative approaches — and they are responsive to new ideas and different approaches based on feedback!

NIC: What advice would you give units considering customization of enterprise EMR's?
KK: It's a misuse of your expertise and time, and it will be a massive effort to get a level of detail that can actually help the care process. For the NICU, Crib Notes should be the measure, and you'll probably never achieve the optimum result working with a system that wasn't specifically designed for this environment. Sure there are some features in Crib Notes that may be found elsewhere, but the overall package works so superiorly.

Input on questions was provided by Michael Paulsen of Crib Notes. If you would like to participate in this feature, as a company or health care provider, please contact Steve Goldstein at s.gold4@verizon.net.

Neo-Tee® Assists Clinicians in Providing Better Patient Outcomes

In this feature, Neonatal Intensive Care interviews clinicians and healthcare providers about the actual application of specific products and therapies. Participating in the interview from Bryn Mawr Hospital: Kim Esposito, RRT-NPS, Clinical Coordinator Respiratory Care Dept.

Neonatal Intensive Care: What areas/departments could the hospital benefit from using the Neo-Tee?
Kim Esposito: Pediatrics, NICU, Labor and Delivery, ER: These are all places that now would have a tool to deliver a safe preset constant PIP and PEEP when resuscitating.

NIC: What device do you use as your primary resuscitation?
KE: NeoPuff but we supplement with Neo-Tee. We also use Neo-Tee solely in areas like ER and Peds where we do not have NeoPuffs.

NIC: When a baby starts to spontaneously breathe, how do you deliver blow-by? (Control FiO2)
KE: With a continuous flow device like the Neo-Tee or NeoPuff.

NIC: What do you do to reduce a baby's work of breathing?
KE: With the Neo-Tee we can easily deliver NCPAP until we get the baby to a unit.

NIC: How does the Neo-Tee assist clinicians in providing better patient outcomes?
KE: It can be preset to deliver a preset PIP and PEEP reducing the cognitive load in stressful situations. It can also help prevent the high pressures that contribute to BPD.

NIC: What is a standard setting you use on the Neo-Tee for PIP and PEEP pressure?
KE: 25/5 flow of 12 is our starting point with blended gas at 21% FiO2.

NIC: Could you share with us any specific incidents where Neo-Tee had a direct impact on patient outcomes?
KE: Yes, there was a case in the ER with a very small baby. It was a discharged preemie now back 4 days later with labored breathing and it was great to have this in the ED. It made transport easy and safe.

NIC: What advantages do you see using Neo-Tee versus previous resuscitation devices?
KE: It is a continuous flow that allow you to have preset safety ready to go and it can do NCPAP.

NIC: How has the manometer benefited you from a clinical standpoint?
KE: It's a must have. It guides you and lets you feel confident it is what you are delivering breath to breath.

NIC: Many clinicians have stated that feeling "lung compliance" with a resuscitation bag is very important. What are your thoughts on this considering that Neo-Tee does not allow for the "feel"?
KE: It true to some degree, but chest rise is key so looking at the chest during breath delivery is very important and the old mapelson required much more work and concentration (cognitive load) and in an untrained hand can cause damage to the lung. [Feeling] can sometimes distract you from looking at the chest rise as well. Neo-Tee is always safe and easy [because] it allows you to remain focused on the patient.

NIC: Has the Neo-Tee prevented intubations that may have occurred by the use of other resuscitation devices? If so, how does this help support reducing healthcare costs? (Can an actual dollar savings be applied to your facility?)
KE: Hard to say. The Neo-Tee does help with the cost in other ways such as preventing lung damage, it is a more economical solution than the NeoPuff and is a more flexible tool.

Input on questions was provided by Scott Horowitz of Mercury Medical. If you would like to participate in this feature, as a company or healthcare provider, please contact Christopher Hiscox or Steve Goldstien at s.gold4@verizon.net.

Experiences Using Vapotherm HFT to Improve Infant Breathing

In this feature, Neonatal Intensive Care interviews clinicians and healthcare providers about the actual application of specific products and therapies. Participating in the interview from Community Regional Medical Center is: Hank Perry RCP, RRT Respiratory Clinical Coordinator, NICU.

Neonatal Intensive Care: Could you please describe your role and department?
Hank Perry: My name is Hank Perry and I have been a Registered Respiratory Therapist for over 30 years. My main focus has been in pediatric and neonatal intensive care. Currently, I am the respiratory clinical coordinator and transport coordinator for our 87-bed Neonatal Intensive Care Unit (NICU) at Community Regional Medical Center (CRMC) here in Fresno, California. As the busiest hospital in the Central Valley (and in California), CRMC's 677 beds are almost always occupied, given its expertise in high-risk obstetrics, neonatal medicine, burn care, and our level I trauma designation. We are also affiliated with the University of California, San Francisco, and actively train medical students and residents in a variety of specialties. As the Clinical Coordinator in the NICU, I am responsible for ensuring that the NICU is adequately staffed and that our respiratory care practitioners (RCPs) are following current evidence-based practice to guarantee the best outcomes for our patients. I also audit and follow a number of quality indicators to measure how well the RCPs are caring for our patients and adhering to the outlined best practices. During this time, I also provide face-to-face education to improve compliance and ownership of delivered care.

NIC: Tell us about the initial adoption of HFT in the hospital?
HP: Eight years ago, while still a level II NICU, the HFT system was delivered to our institution for a trial. Our first patient was a preterm infant with evolving chronic lung disease; he had required a FiO2 of 0.32-0.35 with a flow of 6 LPM while on a competing high flow system. After placing the baby on the Vapotherm HFT system at 6 LPM, the FiO2 was quickly weaned down to a FiO2 of 0.25-0.27. This baby was slowly weaned off of oxygen in the subsequent days and was oxygen-free prior to 36 weeks. This made all of us a believer in the therapeutic delivery and humidification of the Vapotherm device. As we planned for the opening of our Level III NICU, we budgeted for 15 Vapotherm devices, thereby making it the standard for all oxygen delivered by nasal cannula and HFT in our NICU.

NIC: Tell us what value do you see to the use of HFT, for patients and staff?
HP: We have always strived to deliver oxygen therapy by the modality that is best suited for any given patient in our unit. In the neonatal population, HFT is one device that bridges care between nasal CPAP and nasal cannula. Prior to the introduction of the Vapotherm system, I saw many infants develop obstructive apnea because of desiccated nasal membranes and plugging from secretions. These older devices were not able to maintain delivery of 44 mg/L of water vapor at 37C. Because of Vapotherm HFT, it is now rare to see these adverse effects. Reducing obstruction in these small infants is one of the key factors in reducing the incidence of chronic lung disease in our unit. The therapeutic effects of HFT have helped our patients reduce their work of breathing and has reduced their oxygen requirements. Decreased oxygen toxicity and lower rates of chronic lung disease ultimately translate to improved neuro-developmental outcomes for our patients. Given that Vapotherm is a self-contained unit, it is also of immense value to our staff. Setting up HFT without trying to search for wires, probes, heaters and brackets for the bedside translates to more time for patient monitoring (including maintaining Sp02 target limits). The small diameter cannula is easy to secure, improves patient comfort and reduces the need for the RCP to repeatedly readjust the cannula throughout the day. The value to our department, and ultimately to the facility, lies in the minimal upkeep of the Vapotherm device; each unit can be set up once a month, and the nasal cannula itself only requires changing every week. This minimizes labor and supply costs immensely.

NIC: Who and how is it determined which ventilation support modality to provide?
HP: The Neonatologists, Neonatal Nurse Practioners, Registered Nurses, and RCPs all work together in assessing all patients for non-invasive ventilation. Our unit has intubation guidelines that are followed by all, and our goal is to minimize invasive ventilation and utilize non-invasive ventilation in all of our patients. When patients do receive invasive ventilation they receive surfactant and are aggressively extubated within hours to a non-invasive modality. Most babies under 1500 grams and less than 30 weeks will go on to Bubble NCPAP and will be transitioned to HFT when collectively decided by the patient care team. Larger patients are typically placed on HFT or NCPAP depending on the individual patient's needs, severity of respiratory distress, maternal risk factors and response to treatment. We keep things simple and utilize Volume Guarantee

Input on questions was provided by Mark Kolnsberg, BSc, MBA, CPM, CBET, Director of Marketing for Vapotherm. The customer's views expressed in the interview are his own and not Vapotherm's. If you would like to participate in this feature, as a company or healthcare provider, please contact Steve Goldstein at s.gold4@verizon.net.

for ventilation, utilize Bubble for NCPAP, and utilize Vapotherm for HFT and oxygen delivery via nasal cannula. This allows our young teams in our young NICU unit to be experts in deciding the best care for our patients — and our low C.L.D. and R.O.P. rates speak to our successes.

NIC: Tell us when and why HFT is used, for what signs, symptoms, disease states and care paths?
HP: HFT is utilized for many patients with mild to moderate signs of respiratory distress ranging from RDS to TTN to large patients with spontaneous pneumothoraces. We utilize the HFT for the therapeutic effects and for the comfort it gives the patients in delivering non-invasive ventilation. We use HFT for patients with mild to moderate chest retractions, nasal flaring, and intermediate grunting with or without tachypnea. It has been successful in providing the respiratory support required for most of the patients.

NIC: Can you provide a few examples of HFT's effectiveness in avoiding intubations, weaning success, others?
HP: All of our patients that are on bubble NCPAP are transitioned and weaned to HFT. The Neonatologist will typically write orders for a flow range between 2 to 6 LPM and the patient care team will wean the patient as tolerated by monitoring FI02 requirements and the patient's work of breathing along with the patient's HeRO score (heart rate variability monitoring that can represent atelectasis). We have been able to determine the patient's tolerance to respiratory support by monitoring these parameters.

NIC: Is use of the therapy limited to just the ICU in your institution?
HP: HFT is utilized throughout our organization, including the emergency department, acute care, intermediate care and all of the intensive care units.

NIC: How does HFT improve patient outcomes and reduce the cost of care?
HP: HFT offers a multitude of therapeutic advantages that improve patient outcomes. The ability to maximize humidification to improve lung compliance and reduce resistance helps the patient's work of breathing and reduces oxygen requirements. The optimal humidification delivery reduces obstructive apnea related to viscous and bloody nasal secretions. All of these characteristics of HFT combine to reduce chronic lung disease, retinopathy of the prematurity, reduced oxygen days and hospitalization. Our average length of stay (also known as length of separation) is one of the lowest in the state; HFT's many therapeutic benefits may be one of the contributing factors responsible for this. Overall, this decreases the cost of health care significantly. We have averaged over 200 babies each year in 2011 & 2012 less than 1500 grams and less than 30 weeks gestational age. We have one of the highest number of VLBW infants delivered in California and have maintained very low CLD and ROP rates. Remarkably, we have only sent 6 babies home on oxygen in the last 4 years. We believe placing patients on non-invasive ventilation as soon as possible has helped our outcomes and has reduced the cost of care.

NIC: If you had the opportunity to help others introduce the use of HFT for their respiratory therapy practice, what advice would you give?
HP: Besides my roles as Clinical Coordinator and Transport Coordinator, I also provide outreach education to our referring facilities. I have already had the opportunity to provide HFT to other respiratory departments where HFT has since been adopted. This has allowed many of our referring facilities to improve delivered care to their patients and to help stabilize patients for transport when required. I have advised them to utilize HFT on all patients with respiratory distress to improve the work of breathing and to titrate liter flow between 2 to 6 LPM for reduction in all signs of distress. After speaking to the directors, managers, staff and physicians about HFT, I have received favorable feedback that there is improvement in delivered care to the patient after the institution of HFT — an improvement that is visible to us when we assume care of these patients.

Benefits of HALO Swaddling Program in Modeling Safe Sleep Practices

In this feature, Neonatal Intensive Care interviews clinicians and healthcare providers about the actual application of specific products and therapies. Participating in the interview from UAMS Medical Center, University of Arkansas for Medical Services is: Rebekah Thacker, BSN, RNC-NIC, RNIV Clinical Expert – UAMS NICU.

Neonatal Intensive Care: Can you tell us a bit about your hospital NICU — how many babies are you generally taking care of at any given time?
Rebekah Thacker: The University of Arkansas for Medical Sciences (UAMS) NICU is a 64-bed unit with private room design in the state's only teaching medical center. We have approximately 180 nurses that care for infants born prematurely at 23 weeks to full-term, with an average census of 50 babies. We are a high-risk delivery center for the state of Arkansas, which means that many women with high-risk pregnancies deliver in our hospital where their premature infants may be cared for by neonatologists in our NICU.

NIC: How important is swaddling for a preemie? What are the advantages?
RT: Swaddling for a premature infant is extremely beneficial. Swaddling has been shown to decrease stress, provide comfort, improve neuromuscular development and reduce pain scores as well as the expression of pain in premature infants. In addition, HALO offers SleepSack Swaddles made of both 100% Cotton and Microfleece, which aids in thermoregulation of the premature infant based on his or her individual needs. This better facilitates transitioning the premature infant to an open crib once clinically stable.

NIC: What had you been using to swaddle babies before you discovered the HALO Safer Way to Sleep Program?
RT: We had been using standard hospital receiving blankets for swaddling to provide warmth and containment prior to learning about the Halo Safer Way to Sleep In-Hospital program.

NIC: How did you find out about the program?
RT: Our nursing leadership had been discussing ways to model safe sleep for the families of our patients. I had read an article in a professional journal describing how a unit had implemented safe sleep practices using handmade swaddle blankets. The article mentioned that the unit later implemented the use of HALO SleepSack Swaddles. About that same time, one of our nurses attended a nursing conference where a HALO vendor was present and received information about HALO's Safer Way to Sleep in-hospital program in addition to a sample kit. This began our partnership with HALO to develop and implement the Safer Way to Sleep program in our NICU.

Input on questions was provided by Alise Kreditor of HALO Medical. If you would like to participate in this feature, as a company or healthcare provider, please contact Steve Goldstein at s.gold4@verizon.net.

NIC: Did you receive any instructional materials along with the product?
RT: Yes. Produced in partnership with First Candle, HALO provides all the necessary educational materials, including an informative brochure and safe sleep door hanger as a quick reference, in both English and Spanish, to teach our parents about safe sleep. Our nurses also use these materials to teach parents the recommendations of the American Academy of Pediatrics (AAP) regarding safe sleep and how to use the HALO SleepSack Swaddle to reduce their infant's risk of SIDS.

NIC: What are the specific features and benefits of the HALO SleepSack Swaddle as it relates to caring for preemies?
RT: The HALO SleepSack Swaddle specifically designed for premature infants features shoulder openings secured with Velcro. This feature allows easy use of the SleepSack Swaddle in infants that are stable enough to be swaddled but may have intravenous (IV) access sites in the upper extremities. In addition, the zipper is inverted, zipping downward, which allows for easy access to monitor cables and diaper change.

NIC: How does the use of the HALO SleepSack Swaddle help to prevent post natal hip dysplasia?
RT: The Halo SleepSack Swaddle has a bell shape and is designed to be spacious and non-restrictive at the bottom. The "wings" swaddle the chest and arms to provide containment and promote comfort to the upper half of the body while the legs are able to move freely for healthy hip development.

NIC: In addition to being a benefit to patients, what was/is the staff response to using the HALO SleepSack Swaddle?
RT: Our staff response to using the HALO SleepSack Swaddle as a part of our Safer Way to Sleep program was overwhelmingly positive. Six months after implementation of the Safer Way to Sleep program, we developed a nurse response survey to evaluate nurse knowledge and satisfaction with the program. Ninety-seven percent of respondents agreed that the use of the HALO SleepSack Swaddle as part of our Safer Way to Sleep program improved their ability to meet the guidelines of the AAP. Ninety-eight percent of respondents would recommend that the program be taught to health care professionals in other NICUs to standardize the practice of modeling safe sleep.

NIC: Would a full term baby also benefit from using the HALO SleepSack Swaddle?
RT: Term babies experience the same benefits as preterm infants with the use of the HALO SleepSack Swaddle. The

HALO SleepSack Swaddle is designed for infants who need swaddling as well as infants who desire less containment — the "wings" may be wrapped around the infant's chest and tucked underneath the armpits to allow the arms to move around freely. Many term infants experience improved rest and comfort during sleep when swaddled and experience less startling than infants who sleep supine but are not swaddled. In addition, use of the Halo SleepSack Swaddle reduces the risk of SIDS and accidental suffocation by replacing loose blankets in the bed that can cover the infant's face. Parents can rest assured that their infant will stay warm and safe during sleep.

NIC: How important is it for the professional staff to model safe sleep practices in order for parents to learn the proper way to put baby to sleep?
RT: Modeling safe sleep practices with infants is crucial for healthcare professionals. Studies have shown that parents of hospitalized infants tend to continue practices they have witnessed by healthcare providers during hospitalization, regardless of the education they have received prior to discharge. If nurses are telling parents to place infants supine when they go home, but are positioning infants prone for sleep while in the hospital, parents are more likely to continue prone positioning for sleep when they are discharged home. Because premature infants are at an increased risk for SIDS, it is imperative for nurses caring for premature infants to follow AAP recommendations and to reinforce to parents the importance of a safe sleep environment for their infants. The use of the HALO SleepSack Swaddle as part of our Safer Way to Sleep program often sparks this important conversation and education between nurses and caregivers.

NIC: Would you recommend it to other NICUs?
RT: Absolutely. Our partnership with HALO has most certainly enhanced the success of our implementation of the Safer Way to Sleep program at the UAMS NICU. There are a number of resources online, and I would encourage other NICUs to go to the HALO website to learn more about bringing safe sleep to their NICU through the Safer Way to Sleep Hospital Initiative. http://www.halosleep.com/hospitals.

Gastric Residual Osmolality and Refractometry in Preterm Infants with Feeding Intolerance

Kristi Havener, MD, Paula Radmacher, MSPH, PhD, David Adamkin, MD

Abstract

Purpose: Feeding intolerance is a common diagnosis among very low birth weight infants, but it is neither specific nor predictive of necrotizing enterocolitis (NEC). The purpose of this study was to establish the feasibility and clinical applicability of bedside osmometry and refractometry in preterm infants with feeding intolerance or NEC.

Methods: Gastric residuals obtained at the time feeding intolerance was noted by the bedside nurse were analyzed for refractive index (RI) and osmolality. Clinical data included estimated and corrected gestational age (EGA and CGA, respectively), birth weight, current medications, feeding type and known diagnoses. After the specimen was collected, overall clinical status was monitored for possible correlation to the development of NEC, continued intolerance to feedings, or resolution of symptoms. Cohorts were constructed based on CGA <29 weeks, 29-32 weeks and >32 weeks, denoted as groups 1 (n=19), 2 (n=25) and 3 (n=26), respectively. Data analysis was conducted with SPSS v. 20.

Results: Seventy specimens were analyzed from 47 different infants. Median (range) osmolality values (mOsm kg^{-1}) were 344 (271, 526), 324 (131, 387), 312 (210, 518) respectively for groups 1, 2, and 3. Median RI values were 5.8 (2, 12.7), 4.8 (0.9, 13.3) and 2.9 (0.2, 12.2) for groups 1, 2 and 3 respectively. There were no statistical differences in osmolality results when grouped by CGA; RI was significantly higher in infants <29 weeks compared to infants >32 weeks. RI was significantly higher in fed vs. unfed (NPO) infants. Osmolality was significantly higher in group 1 infants who were NPO compared to other CGA groups. Both RI and osmolality were significantly higher in fed infants receiving oral medications compared to fed infants not receiving oral medications. Five infants were diagnosed with NEC near the time of sample collection. Median RI and osmolality values for these infants were 2.8 and 312, respectively. There was no statistical difference in the RI or osmolalities of those samples compared to those who did not develop NEC.

Discussion: Overall, there appears to be no correlation between osmolality and RI in infants displaying signs of feeding intolerance. The osmolality of gastric residuals remained well within the recommended American Academy of Pediatrics (AAP) guidelines for formula osmolality, even for infants with active or impending NEC, suggesting that osmolality is unlikely to be a factor in feeding intolerance. Although not statistically significant, the trend for the osmolality and RI values to be lower at a more mature postnatal age is intriguing and could be the focus of future studies.

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Introduction

Feeding intolerance is common among very-low-birth-weight (VLBW, <1,500g birth weight) infants. Bilious or non-bilious emesis, abdominal distention, increased gastric residuals and episodes of apnea and/or bradycardia can all be included under symptoms of feeding intolerance. Yet none of these symptoms is conclusive or predictive of an impending diagnosis of necrotizing enterocolitis (NEC).

Currently, excessive gastric contents, also called residuals, are commonly cited as an indicator of feeding intolerance or as an early symptom of NEC. Yet, there is limited research that identifies even normal gastric contents from that which is pathologic. There are no known ranges of quantity or consistency of gastric residuals that are normal for a specific age or weight, making it unclear when it is indicative of gastrointestinal dysfunction. A prospective study of VLBW infants demonstrated larger gastric residuals were associated with NEC, but there was overlap with controls.[1] In another study of extremely low birth weight (ELBW, <1000 g BW) infants, green gastric residuals did not correlate with feeding intolerance or the development of NEC.[2] The speed of gastric emptying and peristaltic patterns exhibited in the neonate have been shown to be affected by body position,[3] rate of infusion of the feeds,[4] and composition of the feeds.[5-7] Thus neither the amount nor the color of gastric contents is a reliable indicator of impending disease.

Osmolarity and osmolality are commonly used interchangeably but do not convey the same information. Osmolarity is volume-based — osmoles of solute per liter of solution (Osm L^{-1}). Osmolality is weight based--osmoles of solute per kilogram of solvent (Osm kg^{-1} H_2O). Hyperosmolality refers to osmolality greater than that of serum (275-295 mOsm kg^{-1}).[8] Normal digestion of complex molecules yields increased numbers of soluble, osmotically active particles and increases the osmolality of luminal fluid compared to the original food product. It is widely believed that hyperosmolar substances affect the gastrointestinal system in various, and sometimes detrimental ways, such as ileus or NEC.[9,10] The osmolarity of most mammalian milk is about 300 mOsm L^{-1}.[11] For these reasons, the

Table 1: Demographic information.

	Cohort 1 <29 weeks CGA* n = 19	Cohort 2 29-32 weeks CGA* n = 25	Cohort 3 >32 weeks CGA* n = 26
BW <1000 g (n, %)	15 (79%)	14 (56%)	4 (15%)
GA at birth <28 wks (n, %)	19 (100%)	14 (56%)	3 (12%)
Weight < 1000 g at study (n, %)	16 (84%)	11 (44%)	1 (4%)
Males (n, %)	12 (63%)	11 (44%)	16 (61%)
<28 days old at study (n, %)	18 (95%)	14 (56%)	16 (61%)

*Corrected gestational age (GA at birth + postnatal age in weeks).

Table 2. Comparison of refractive index (RI) and osmolality (mOsm kg-1) by feeding status.

Refractive Index			
CGA group	NPO	Fed	p
<29 wks	4.6 ± 1.6	7.3 ± 3.1	0.048
29-32 wks	3.0 ± 1.3	8.6 ± 3.7	<0.001
>32 wks	2.6 ± 1.3	7.5 ± 3.4	<0.001
Osmolality			
<29 wks	406 ± 85	327 ± 26	Not significant
29-32 wks	296 ± 79	328 ± 60	Not significant
>32 wks	328 ± 61	337 ± 71	Not significant
	p < 0.015 (<29 wks vs. 29-32 wks and >32 wks)	Not significant	

*Corrected gestational age (GA at birth + postnatal age in weeks).

Table 3. Comparison of refractive index (RI) and osmolality (mOsm kg-1) of gastric residuals from fed infants with and without oral medications.

	Oral medication* n=17	No oral medication n=17	p
Refractive Index	9.8 ± 2.5	5.9 ± 3.0	<0.001
Osmolality	355 ± 50	305 ± 45	<0.001

*Oral medications included caffeine citrate, multivitamins, ferrous sulfate, electrolyte supplements, spironolactone and chlorothiazide.

American Academy of Pediatrics suggests limiting the osmolarity of enteral milk products to 400 mOsm L^{-1}, a recommendation which is based on clinical consensus rather than experimental evidence.[12]

A study in the 1980s found that many commonly used medications exceeded the AAP recommended limit.[13] In 2011, Radmacher et al reported another study in which the osmolality of frequently used milk and enteral medication combinations given to VLBW infants were tested.[14] The findings echoed those of Ernst and colleagues, with the addition of vitamins alone exceeding the AAP recommendations. Billeaud and colleagues found "a significant linear correlation between the osmolality of the diet and the osmolality in the stomach and duodenum."[15] Another study examined the postprandial osmolality following administration of expressed human milk and several additives and found that the osmolality never exceeded 400 mOsm kg^{-1}.[16]

Refractive index (RI) is a measurement of the degree of light scattering due to substances within translucent liquids and is a function of solute concentrations and ambient temperature. The clinical application of this principle to gastric residual analysis, known as a Brix value, has been studied in the adult critical care setting and shown to aid in the monitoring of intolerance and gastric emptying.[17-19] Elevated Brix values suggest that there has been less digestion of stomach contents and that there may be an increased likelihood of subsequent feeding intolerance.

The primary purpose of this study was to evaluate two different methods of examining gastric specimens from infants exhibiting signs or symptoms of feeding intolerance. A secondary purpose was to determine the clinical applicability of bedside osmolality and RI measurements.

Methods

This study was approved by the University of Louisville Institutional Review Board prior to initiation. Eligible infants were <37 weeks gestational age at birth with a naso-gastric or oro-gastric tube in place. Gastric aspirates (<0.4 mL) were obtained for analysis when nursing staff observed signs of feeding intolerance: abdominal distention, emesis, etc. Refractive index (RI) was analyzed using a pre-calibrated PAL-1 portable digital BRIX Refractometer (Pulse Instruments, Van Nuys, CA). Osmolality was measured by freezing point depression with an Advanced Model 3320 Osmometer (Advanced Instruments, Norwood, MA). Both osmolality and RI analyses were completed within 1 hour of collection.

Clinical and demographic data were collected: birth weight, estimated gestational age, date and time specimen was collected, any medications, (if) what the patient is being fed and other concomitant diagnosis such as gastroschisis, intrauterine growth restriction (IUGR), and respiratory distress syndrome. After the specimen and data were collected, overall clinical status was

Table 4. Data on five cases of NEC

	1	2	3	4	5
EGA	23 + 1	23 + 2	25	28 + 3	35 + 6
CGA	30 + 6	30 + 5	26 + 1	31 + 2	36 + 2
DOL	54	52	8	19	3
BW (g)	530	540	686	1080	3572
Bilious	No	Yes	Yes	No	No
Bloody	Yes	No	Yes	Yes	Yes
Distention	Yes	Yes	Yes	Yes	Yes
X-ray finding	Portal venous gas	Pneumatosis	Fixed loop, free air	Pneumatosis	Pneumatosis
Feeds	NPO > 1 wk	27 kcal DHM	MBM 1 mL x 1	24 kcal DHM	Term formula
Enteral meds	None	None	None	Caffeine, PVS, Fe	None
RI	2.8	2.5	4.5	7.4	2.3
mOsm kg-1	263	275	314	358	312

Figure 1. Osmolality of gastric residuals (mOsm kg-1) in infants identified with "feeding intolerance" (median, 10th, 25th, 75th, 90th percentiles) by corrected gestational age cohorts.

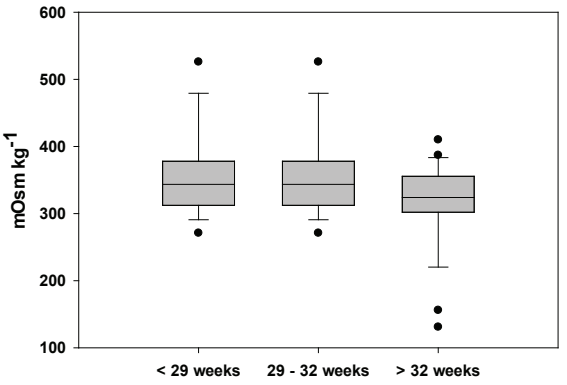
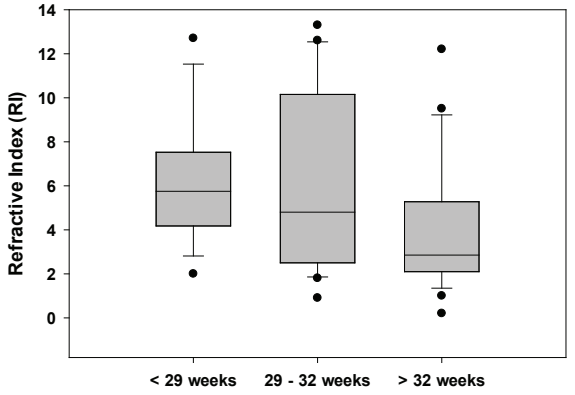


Figure 2. Refractive index (RI) of gastric residuals in infants identified with "feeding intolerance" (median, 10th, 25th, 75th, 90th percentiles) by corrected gestational age cohorts. (p=0.012: 29-32 weeks vs. >32 weeks).



monitored for a week in order to correlate with the development of NEC, continued intolerance, or resolution of symptoms. Three cohorts were established based on corrected gestational age (CGA) at the time of sampling: <29 weeks, 29-32 weeks, and >32 weeks.

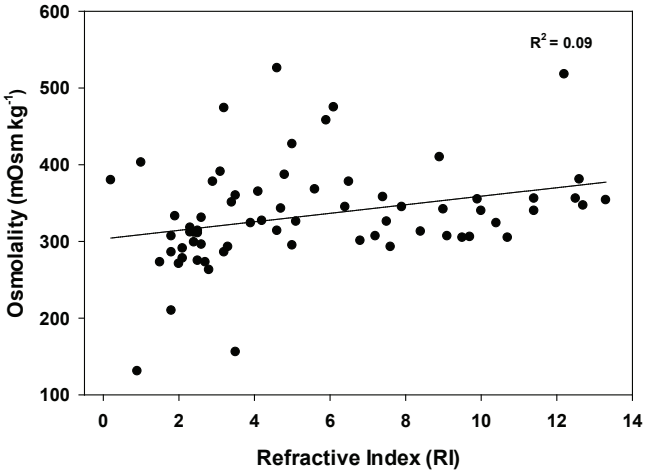
Continuous data were analyzed by t-test. Categorical data were analyzed by chi square. Statistical analysis was conducted with the Statistical Package for the Social Sciences (SPSS) version 20 and significance was set at $p<0.05$.

Results

A convenience sample of 70 gastric residuals from 47 different subjects was collected over an eight month period. For analysis, these samples were grouped into 3 different cohorts of CGA: <29 weeks (n= 19), 29-32 weeks (n= 25), and >32 weeks (n= 26). Demographic data are displayed in Table 1. Median osmolality values (mOsm kg^{-1}) showed no statistically significant differences by group but a downward trend with increasing CGA (Figure 1). Median RI values showed statistically significant differences between infants <29 weeks and those >32 weeks. There was a downward trend with increasing CGA (Figure 2). There was no significant correlation between the osmolality and RI among these samples (Figure 3).

When comparing RI among all infants by feeding status (NPO or fed), RI was significantly higher in fed infants at all CGA, while osmolality was significantly higher in infants <29 weeks CGA vs. the other groups among the NPO infants (Table 2). In neonates

Figure 3. Correlation of refractive index (RI) with osmolality (mOsm kg-1).



that were being fed and receiving oral medications (including caffeine citrate, multivitamins, ferrous sulfate, electrolyte supplements, spironolactone and chlorothiazide), both RI and osmolality of gastric residuals were significantly higher compared to infants being fed and not receiving oral medications (Table 3). There were five infants diagnosed with NEC from whom samples were obtained at the onset of symptoms. Detailed data (Table 4) showed a wide range of RI and osmolality values without evidence of hyperosmolality.

Discussion

Hyperosmolality of enterally administered solutions has been commonly believed to be a risk factor for NEC. The AAP suggests a limit of 400 mOsm L^{-1} for infant formulas yet no quantitative evidence for a threshold value has been reported. Pearson et al suggest that while hyperosmolar solutions delay gastric emptying, studies in adult animals do not show direct mucosal injury as a consequence.[12] However, given the frequency of adding various compounds (supplemental electrolytes, multi vitamins and minerals, etc.) and the evidence for significant increases in osmolality especially due to multiple additives, the authors suggest that these substances be diluted as much as possible prior to administration.

In this study, gastric residual osmolality values varied widely, with the majority (93%) under 450 mOsm kg^{-1}. There was a downward trend with increasing CGA, the significance of which may be related to the maturation of digestive processes in the first weeks after birth.[20] Among infants that were NPO at the time of sampling, mean osmolality was significantly higher than at other times but remained below 450 mOsm kg^{-1}. While this study was not powered to detect significant differences in infants with NEC from those without NEC, among infants who were at an early period in the evolution of their disease, osmolality values did not exceed the 75th percentile.

RI (Brix) values have been studied in adult intensive care patients and found to provide helpful information that assists the clinician in evaluating tolerance to enteral feeding.[19,21] This is the first report of this measurement in infants. The significantly higher values in fed vs. not fed infants are not surprising since infants that are NPO have only normal gastric fluid in their stomachs. Although no correlation was seen between RI and measured osmolality in this study, further evaluation is necessary before determining its usefulness.

The lack of normative data for both osmolality and RI limit interpretation of the results from this study. However, the downward trend of osmolality and RI with advancing infant age seen in this study, suggest that distinctive ranges could be established with further study. While the data from babies with a diagnosis of NEC do not appear to point to any increase in osmolality as a triggering factor, the number of infants is too small for an assessment of clinical utility.

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Managing Leaks in Mechanical Ventilation of the Neonate

Gary Milne, BS, RRT

Over the last three decades, approaches to ventilating neonates have improved dramatically. Clinicians can use synchronized modes, can target volumes and can manually adjust trigger sensitivity to improve ventilator trigger responsiveness. They can also adjust the rise to pressure and even adjust "cycle-off" thresholds (specific to pressure support). In addition, there has been a significant increase in the use of non-invasive ventilation, which has the major advantage of not requiring the insertion of an artificial airway into the neonate's airways. However, this mode of ventilation is very prone to system leaks due to the ill-fitting patient interface.

Incidence

The presence of these system leaks continues to be a challenge when ventilating neonates. Leaks are usually caused by the tracheal tube (TT). In a retrospective study, TT leaks >5% have been noted in as many as 75% of infants. These leaks can cause clinically significant errors in the displayed tidal volume (V_T). For TT leaks greater than 40%, V_T may be underestimated by as much as 24% of the target.[1,2]

In a study of 50 ventilated infants by Bernstein et al., 70% had leaks >10%, and of these 14% had leaks of 20% to 30% while 48% had leaks of 10% to 20%. Auto-triggering, a form of patient-ventilator asynchrony, was a frequent complication associated with leaks.[3]

Causes of Leaks

One obvious cause of system leaks is an uncuffed endotracheal tube. Even though there are endotracheal tubes with cuffs, uncuffed tubes are typically used in the neonatal population to minimize any airway injury. Another cause of leaks is the simple movement of the head or body position. Inappropriate tracheal tube size can also contribute to leaks. In some cases, excessive leaks can be resolved by switching to a larger tube.[1,2]

Consequences

The impact of leaks on mechanical ventilation can vary from minor to significant. Two of the consequences of leaks that impact patient-ventilator synchrony are auto-triggering and delayed cycling. Auto-triggering occurs when the ventilator delivers a breath in the absence of any patient effort (trigger). This can occur when the trigger sensitivity is set too low for patient conditions, such that the ventilator senses a trigger/effort when one is not present. For example, on some ventilators, if the leak rate is 2 L/min and the set sensitivity is 0.5 L/min (far below the leak rate), the ventilator will auto-trigger, causing unnecessary breath delivery and asynchrony. Delayed cycling occurs when the end inspiratory flow threshold is not being met due to leaks. Gases continue to flow but, due to leaks in the system, the flow rate does not meet the threshold, thus extending the duration of the spontaneous breath. The duration of the breath can exceed the desired inspiratory time (inspiration does not end at the appropriate time), resulting in asynchrony.

How Ventilator Design Has Improved Patient-Ventilator Synchrony

In the past clinicians did not have the ability to set the trigger sensitivity, and there was no synchronous intermittent mandatory ventilation (SIMV) because there were no settings for sensitivities. Today there are trigger sensitivity settings that bring synchronized mandatory breath types. A notable advance in the ventilation of neonates is the capability to perform both invasive and non-invasive SIMV. Today clinicians can also set and adjust the inspiratory sensitivity for a multitude of ventilator strategies and set the expiratory sensitivity to handle the impact of leaks on the termination of breaths. While adjusting the sensitivity manually can be a challenge, there are some signs that can help you detect when leaks are occurring, as discussed in the next section.

Estimating Leaks with the Use of Graphics to Manually Adjust Sensitivity Settings

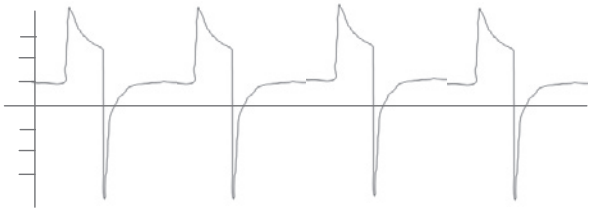

Figure 1. Flow-time waveform with a leak.

When system leaks are present there will be an elevated baseline on the flow-time waveforms, as shown in Figure 1. Figure 1 shows signs of a leak during pressure-controlled ventilation (PCV) as displayed on a Puritan Bennett 840 ventilator. Examination of the waveform can help the clinician estimate the leak, which in turn will allow the clinician to determine the appropriate inspiratory sensitivity setting. On some ventilators, if the leak is 2 L/min, the clinician will need to adjust the inspiratory sensitivity above this level. Reassessment of the correct setting should be done with position changes.

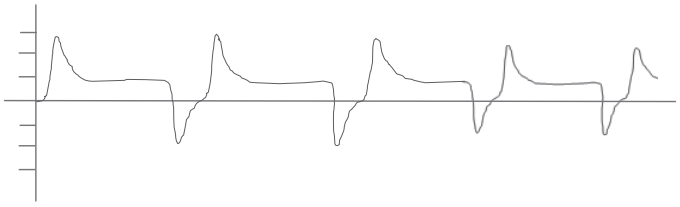

Figure 2. Flow-time waveform—use with expiratory sensitivity setting in pressure-support ventilation.

During pressure-support ventilation, end inspiratory flow is typically used as the cycling mechanism, though time is also used. When a leak is present, the end inspiratory flow may not taper down to the level of the expiratory sensitivity setting during inspiratory phase as it should, so the waveform can be abnormally shaped (see Figure 2). In Figure 2, the elevated inspiratory baseline represents prolonged inspiratory flow. End inspiratory flow did not reach the cycling threshold and flow continued until it reached a time limit.

This can cause a significant amount of asynchrony between the patient and the ventilator. In addition to monitoring graphics, the simple monitoring of spontaneous inspiratory time can also aid in detecting delayed cycling. If ventilation is initiated with prolonged spontaneous inspiratory times, the clinician may consider adjusting the expiratory sensitivity. For example, on the Puritan Bennett 840 ventilator an increase in expiratory sensitivity will shorten the inspiratory time of the spontaneous pressure-support breath. It is good to assess both the graphics and the spontaneous inspiratory time in the patient data section of the ventilator to determine optimal settings.

Advances in Leak Compensation

The definition of leak compensation varies between ventilators. It is always good to determine exactly how the software performs:

- Does it just stabilize the PEEP by adding bias flow?
- Does it make automatic adjustments during leak conditions so that auto-triggering may be reduced without manual adjustments?
- Does it make automatic adjustments during leak conditions so that delayed cycling will improve?
- To what level will the software compensate during exhalation while trying to maintain PEEP conditions and prevent auto-triggering?

The Future

With advances in leak compensation, clinicians may move toward the use of synchronized non-invasive SIMV. In a previous study, Barrington et al. compared the use of NSIMV PCV vs. non-invasive continuous positive airway pressure (NCPAP) to determine which approach improved the likelihood of successful extubation in very low birth weight infants.[4] Results showed that the NSIMV group had a lower incidence of failed extubation compared with the NCPAP group (4/27 vs. 12/27).

Summary

The incidence of airway leaks in neonates is high. The leaks can cause patient-ventilator asynchrony to occur as a result of both auto-triggering and delayed cycling. The use of graphics can help clinicians manage the appropriate manual settings of sensitivity. Automated leak compensation software programs have improved greatly and can assist the clinician in managing leaks in the neonatal population. Since many clinicians are increasingly using non-invasive approaches to ventilation, leak management will become more and more important.

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Using Pulse Oximetry Technology to Screen for Critical Congenital Heart Defects (CCHDs) in Newborns

Kendall Qualls

The process of having a baby can be extremely overwhelming. There are a number of different tests and screenings that newborns undergo, which can be very confusing — and not all tests, even life-saving tests, are mandatory. As an organization that provides the device that makes one such life-saving test possible, we believe it is important that clinicians and parents are aware and understand the value of pulse oximetry screenings in newborns.

Critical congenital heart defects (CCHDs) are the most common birth defects and account for nearly 30 percent of infant deaths, but parents are largely unaware of the risks and a majority of newborns are not screened before they leave the hospital.[1] At Covidien, we feel that there is no reason why any newborn should leave the hospital without receiving a painless, noninvasive and inexpensive pulse oximetry screening.

The use of pulse oximetry screenings is rapidly being adopted, but not all states have requirements in place for mandatory hospital screenings. Currently, only about 30 states have legislation that requires the test. However, awareness of the issue is growing, and states are starting to issue legislation requiring CCHD screenings at birth.

As more and more states adopt mandatory screenings, it is important for the medical device industry to support hospitals and clinicians as they strive to become compliant. By providing educational resources and training, Covidien is committed to raising awareness around the importance of pulse oximetry technology and how it can save a child's life.

Pulse Oximetry and CCHD Screenings

Pulse oximetry screening is a simple bedside test to determine the amount of oxygen in a baby's blood and the baby's pulse rate. Low levels of oxygen in the blood or differences in oxygen measurements between the right hand and the measured foot can be an early sign of a CCHD. The test is performed using a monitor called a pulse oximeter, with sensors placed on the baby's right hand and either foot. It is painless and takes only a few minutes. Screening is done when a baby is 24 to 48 hours of age, or as late as possible if the baby is to be discharged from the hospital before he or she is 24 hours of age.

Nellcor pulse oximetry technology from Covidien is an example of pulse oximetry technology that has been shown to be a simple and economical tool to aid healthcare providers in CCHD screening.[2] It provides highly accurate readings in neonates (±2 digits), largely because it relies on cardiac-based signals to generate readings closely tied to the patient's physiology. The result is consistent performance during a number of challenging conditions, including patient motion, noise and low perfusion, all of which can impede the assessment of patient respiratory status.

Adoption

In August 2011, a panel of pediatric and cardiac experts from the American Academy of Pediatrics (AAP), the American College of Cardiology (ACC), and the American Heart Association (AHA), in conjunction with the HHS Secretary's Advisory Committee on Heritable Disorders in Newborns and Children (SACHDNC), acted on the HHS 2010 recommendation and outlined a strategy for routine screening of newborns to improve detection of CCHD.

The 28-page report recommends that newborn screening be performed with "motion-tolerant pulse oximeters that report functional oxygen saturation, have been validated in low perfusion conditions, have been cleared by the FDA for use in newborns, and have a two percent root-mean-square accuracy." Covidien offers highly accurate pulse oximetry technology that meets all of these recommendations.[3]

In September 2011, the United States Department of Health and Human Services approved adding screening for critical congenital heart defects (CCHDs) with pulse oximetry to the Recommended Uniform Screening Panel. CCHD screening is also recommended by the United States Department of Health and Human Services, the American Heart Association and the American Academy of Pediatrics.

Since the introduction of those guidelines, more than 30 states have enacted legislation for mandatory CCHD screenings in newborns. New Jersey, the first state to implement required CCHD screening in newborns, recently conducted a study[4] that showed that pulse oximetry screening is effective in identifying infants with previously undetected CCHDs. The study identified three out of the 30 infants tested as having CCHDs. Left untreated, these CCHDs could result in significant health problems and even death.

Covidien has joined with national and international health

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organizations, as well as state and local grassroots groups, to advocate for mandatory pulse oximetry screening for newborns. In addition, Covidien is working with lobbyists across the country to raise awareness and promote legislation. Current state legislation information can be found at http://cchdscreeningmap.org.

Educational Resources

As part of a broad effort to educate clinicians on the importance of CCHD screenings and encourage hospitals to implement routine CCHD screening for all newborns — Covidien has begun labeling and promoting the use of Nellcor pulse oximetry as a tool to aid healthcare practitioners in CCHD screening. The products used to screen for CCHD are important, but it's the training and education on how to use these products that are critical to the CCHD screening process.

There are a number of resources that clinicians can access to learn and understand how to use and interpret pulse oximetry readings. Covidien offers free CCHD educational resources through its new Professional Affairs and Clinical Education (PACE) Online Platform.[5]

Final Thoughts

With continued efforts from lobbyists, clinicians and parents, the adoption of mandatory CCHD screenings is on the rise. There is simply no reason to send babies home without a quick, painless and inexpensive screening test that can point to a possible life-threatening heart problem. It's important for the medical device community to make education a priority to help protect the most vulnerable patients.

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for WWBS, the evidence underlying clinical care standards remains limited.

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Time to Initiation of Breastfeeding and Neonatal Mortality and Morbidity: a Systematic Review

Amanda K Debes, Anjalee Kohli, Neff Walker, Karen Edmond and Luke C Mullany

Abstract

Background: Early breastfeeding is defined as the initiation of breastfeeding within 24 hours of birth. While the benefits of breastfeeding have been known for decades, only recently has the role of time to initiation of breastfeeding in neonatal mortality and morbidity been assessed.

Objective: To review the evidence for early breastfeeding initiation practices and to estimate the association between timing and neonatal outcomes.

Methods: We systematically reviewed multiple databases from 1963 to 2011. Standardized abstraction tables were used and quality was assessed for each study utilizing the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology. Three meta-analyses were conducted for mortality among babies surviving to 48 hours.

Results: We identified 18 studies reporting a direct association between early breastfeeding initiation and neonatal mortality and morbidity outcomes. The results of random effects analyses of data from 3 studies (from 5 publications) demonstrated lower risks of all-cause neonatal mortality among all live births (RR = 0.56 [95% CI: 0.40 – 0.79]) and among low birth weight babies (RR=0.58 [95% CI: 0.43 – 0.78]), and infection-related neonatal mortality (RR = 0.55 [95% CI: 0.36 – 0.84]). Among exclusively breastfed infants, all-cause mortality risk did not differ between early and late initiators (RR = 0.69 [95% CI: 0.27 – 1.75]).

Conclusions: This review demonstrates that early breastfeeding initiation is a simple intervention that has the potential to significantly improve neonatal outcomes and should be universally recommended. Significant gaps in knowledge are highlighted, revealing a need to prioritize additional high quality studies that further clarify the specific cause of death, as well as providing improved understanding of the independent or combined effects of early initiation and breastfeeding patterns.

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Background

Millennium Development Goal (MDG) 4 aims to reduce under-five mortality by two-thirds, globally by 2015. Since the goals were set the under-five mortality rate has dropped by 35 percent, and the rate of decline in under-five mortality continues to improve, from 1.9% per year from 1990 to 2000 to 2.6% from 2000 to 2009.[1] However, the global community is still behind schedule to meet the 2015 deadline. The percent of under-five deaths that occur during the neonatal period, the first month of life, has increased from 10% in 1990 to 40% as of 2010;[2] deaths in this period are primarily due to preterm birth, intrapartum-related hypoxic events, and infections.[2] Thus, the work to reduce under-five mortality is increasingly focused on neonatal mortality in order to achieve the overall reductions necessary to meet MDG 4.

Studies on the benefits of breastfeeding have demonstrated substantial benefits for child health.[3,4] The recommendation for exclusive breastfeeding in newborns and infants has a long history, and research has demonstrated that breastfeeding protects against many illnesses and infectious diseases, including reducing the risk of diarrhea,[5] respiratory infections especially pneumonia,[6] meningitis,[6] and neonatal sepsis.[6-9] Attention has largely focused on the protective effects of breastfeeding in the first year of life, and in particular, greater protection appears to be conferred in the first six months of life.[10] Only recently, however, has attention been directed towards both the pattern of breastfeeding as well as the timing of initiation of breastfeeding and the effects on neonatal morbidity and mortality.[11] While research assessing the importance of breastfeeding over the past century has reinforced the protective effect of breastfeeding, including in the neonatal period, few studies have assessed the impact of the *time to breastfeeding initiation* on infant and neonatal mortality and morbidity. We conducted a systematic review to estimate the relationship between early initiation of breastfeeding (<24 hours after birth) on neonatal (<28 days) mortality and morbidity.

Methods

A systematic review was performed on all literature published from 1963 to 2011 to identify studies evaluating the early initiation of breastfeeding and its association with neonatal outcomes. Pubmed, EMBASE, Popline, USAID reports, LILACS database and Cochrane Libraries were searched and publications in any language were included. We conducted our initial search of Pubmed, Embase, Popline and USAID reports on June 5, 2011, and two updated searches on November

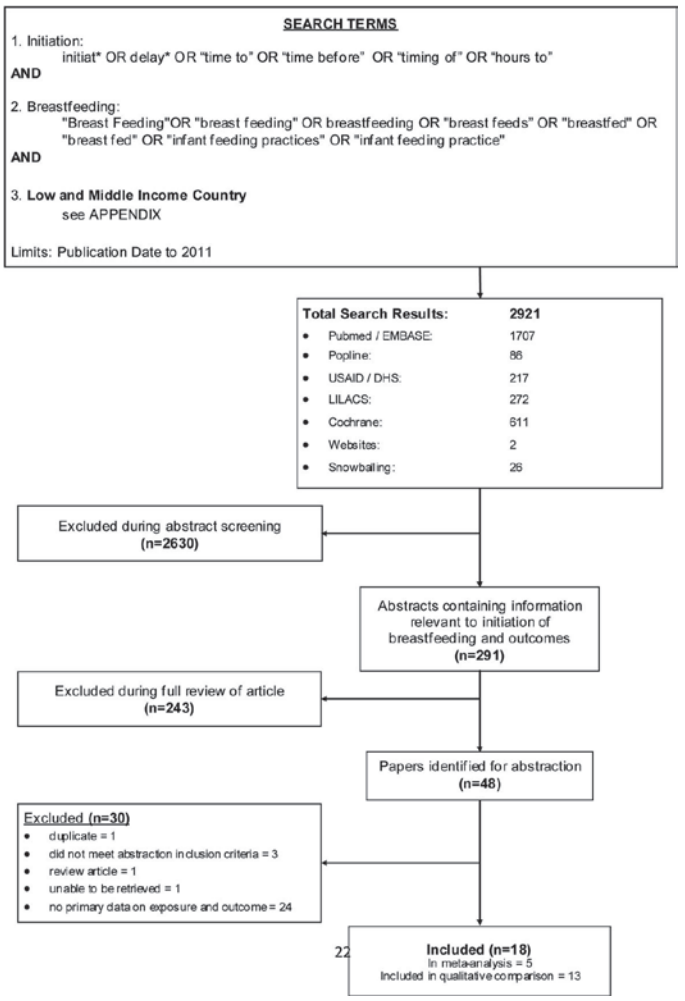

Figure 1. Flow diagram of systematic review

18, 2011 of the LILACS database and on December 9, 2011 (the Cochrane Libraries). Additionally, several key websites were reviewed to identify workshops or reports relating to breastfeeding initiation. Combinations of the following search terms were used in these searches: "breastfeeding," "initiation," "timing," "delay," "neonatal" and "infant." The terms specifically targeting "morbidity" or "mortality" were not included to allow for a broader search; this method was utilized to reduce any unintentional filtering of studies that might have reported an unexpected outcome or phrased the results in a unique manner. These searches were initially performed to review literature from all countries to ensure publications from all settings were included. Subsequently, the search was conducted with a low- and middle-income country filter to further focus the search (see Figure 1 for search terms and Additional File 1 for low and middle income countries filter terms). Finally, we reviewed the references of all relevant papers to ensure that all pertinent papers were identified.

Additional file 1. Search terms used in analyses.

Articles were initially screened based on title and abstract, selecting for studies specific to time to breastfeeding and infant (<1 year of age) or neonatal (<28 days) outcomes of morbidity and mortality. Subsequently, publications selected for full review were evaluated using additional inclusion and exclusion criteria. Only articles that directly linked primary data on exposure (time to initiation of breastfeeding) to one or more infant/neonatal outcomes (mortality or morbidity) were retained. Morbidity outcomes included infectious diseases, diarrhea, sepsis, malnutrition, omphalitis, weight loss, and growth. Many studies reported breastfeeding initiation time as one of the variables accounted for when assessing neonatal mortality and morbidities, but if no attempt was made to compare initiation time with the outcomes the study was excluded. We considered prospective studies, including randomized control trials, observational studies and cohort studies. Retrospective studies were considered but rated with a lower grade due to the biases such studies may impose on assessment of the relationship.

We excluded any studies that did not fulfill the inclusion criteria, as well as duplicate studies. We excluded studies with data presented in a form that was unclear or difficult to interpret.[12,13] Additionally, for studies in which one or more neonatal outcomes were compared across multiple exposures, we only abstracted data on the effects of time to initiation of breastfeeding and the reported morbidity. All aspects of screening, including abstracts review, full article review and abstraction of relevant studies were completed using double-data abstraction into a standardized form.

In this review, breastfeeding initiation time data was abstracted and, if possible, re-organized according to our target definition of early initiation of breastfeeding: i.e. within 24 hours of birth ("early") or equal to or after 24 hours since birth ("late"). For the purposes of reorganization, data reported in multiple shorter time intervals between birth and 24 hours were combined (i.e. <2 hours, 2-24 hours), and compared to late initiation. In some instances, data reported used an alternate binary cutoff (i.e. <2 hours vs. ≥2 hours, or <6 hours vs. ≥6 hours, etc.), and no re-organization of the data was possible. We did not stratify results according to shorter time periods to breast feeding initiation, such as a period of <12 hours or <1 hour as these data are not consistently reported in the literature.

All studies that met the inclusion criteria for the full article screen were abstracted using a standardized form. The data

Table 1 Criteria used to rank included studies as high, medium, and low quality for inclusion in meta-analysis

Ranking	Quantified BF – outcome relationship	Accounting for Reverse Causality	Adjustment for potential confounders	Study Design
HIGH	Required. Must cover/quantify the outcome relationship during the neonatal period	Required. Must remove from analysis babies that might have not been breastfed early as a result of their status/illness	Required. Must adjust for gestational age and/or low birth weight. Adjustment for other confounders desirable	Prospective cohort, RCT
MEDIUM	Required. Must cover/quantify the outcome relationship during the neonatal period	No	Required. Must adjust for gestational age and/or low birth weight. Adjustment for other confounders desirable	Prospective cohort, RCT
LOW	Required. Must cover/quantify the outcome relationship during the neonatal period	No	No	Case control, retrospective

Table 2 Summary of included studies presenting estimates of association between early breastfeeding initiation and all-cause mortality

Study, Location	Sample Size	Study	Def of BF Exposure	Comment/Conclusions	Grade
All-cause neonatal mortality, among all infants surviving to 48 hours or more					
Mullany [11], Nepal, community	22,838	prospective cohort	early vs. late	Early breastfeeding initiation was associated with a lower risk of mortality: RR=0.71 (0.54, 0.93)	HIGH
Edmond [20], Ghana, community	10,947	prospective cohort	early vs. late	Early breastfeeding initiation was associated with a lower risk of mortality: RR=0.43 (0.31, 0.61)	HIGH
Garcia [24], India, community	10,464	prospective cohort	early vs. late	Early breastfeeding initiation was associated with a lower risk of mortality: RR=0.56 (0.32, 0.97)	HIGH
Bamji [31], India, community	378	case control	early vs. late	Reported a significant association between early initiation and a reduction in neonatal mortality	LOW
All-cause neonatal mortality, among low birth weight infants surviving to 48 hours or more					
Mullany [11], Nepal, community	22,838	prospective cohort	early vs. late	Early breastfeeding initiation was associated with lower risk of mortality: RR=0.63 (0.44, 0.90)	HIGH
Edmond [22], Ghana, community	10,947	prospective cohort	early vs. late	Early breastfeeding initiation was associated with lower risk of mortality: RR=0.37 (0.14, 0.98)	HIGH
Garcia [24], India, community	10,464	prospective cohort	early vs. late	Mortality was lower among those breastfed early, but not statistically significant: RR=0.54 (0.28, 1.04)	HIGH
All-cause neonatal mortality, among exclusively breastfed infants surviving to 48 hours or more					
Mullany [11], Nepal, community	22,838	prospective cohort	early vs. late	No evidence that early breastfeeding was associated with mortality: RR=1.21 (0.49, 2.98)	HIGH
Edmond [22], Ghana, community	10,947	prospective cohort	early vs. late	Early breastfeeding initiation was associated with lower risk of mortality: RR=0.46 (0.29, 0.72)	HIGH

were compiled and ranked according to the outcome of measure using an assessment of outcome quality derived from the Child Health Epidemiology Reference Group (CHERG) guidelines. Per the CHERG guidelines, the quality of evidence provided in each study was scored as low, medium or high quality;[14] the definitions for each grade is shown in Table 1. We only included papers with a high ranking in any meta-analysis of the association between initiation of breastfeeding and neonatal outcomes. In addition to requiring that the study presented a quantified estimation of the relationship between breastfeeding initiation time and the outcome, the ranking system placed a high value on papers that 1) accounted for reverse causality, 2) adjusted for important confounders including gestational age and low birth weight, and 3) were prospective in design.

It is important to establish temporality prior to the onset of illness or death in order to properly measure the association between breastfeeding initiation time and this outcome. For examination of the association with mortality, only studies that excluded deaths occurring within the first 48 hours after birth were given high ranking. Additionally, studies were considered as either high or medium grade if the authors adjusted for low birth weight and prematurity. This is necessary to control for selection bias in women who either do not initiate breastfeeding, delay initiation of breastfeeding, or partially breastfeed as a direct result of the health status of the infant.[10] This type of selection bias is prone to increasing the perceived benefits of breastfeeding initiation time on child survival. Studies that examine timing of breastfeeding and infant health outcomes should adjust for reverse causality (i.e. baby's or mother's health status) to avoid over-reporting of the benefits of breastfeeding. [15] Studies should additionally adjust for infant health at birth or in the proceeding days to account for medications or liquids that might be given to treat illness. Further, the feeding practice at death or during illness may not be the feeding pattern practiced prior to this outcome.[10] To account for these types of biases, studies were weighted as low if the authors did not account for low-birth weight, prematurity or reverse causality (due to congenital abnormalities or any other serious illness that is not related to the outcomes of interest). Studies that

Table 3 Summary of included studies presenting estimates of association between breastfeeding initiation and cause-specific mortality

Study/References	Ghana	Nepal	India
Author (Year)	**Edmond (2006)**	**Mullany (2008)**	**Garcia (2011)**
Location	Community	Community	Community
Sample Size	10,947	22,838	10,464
Design	Prospective cohort	Prospective cohort	Prospective Cohort
Definition of Exposure	Early vs. late	Early vs. late	Early vs. late
Cause of Death Outcome			
- **Infection**	0.39 (0.26 – 0.61)	0.70 (0.46 – 1.06)	0.68 (0.30 – 1.54)
- **Sepsis**	0.38 (0.20 – 0.83)	0.61 (0.38 – 0.97)	0.20 (0.07 – 0.60)
- **Birth Asphyxia**	0.45 (0.15 – 1.41)	0.48 (0.12 – 1.98)	0.79 (0.11 – 5.94)
- **Premature**	0.73 (0.24 – 1.45)	0.44 (0.19 – 1.00)	n/a
Grade	HIGH	HIGH	HIGH

Table 4 Summary of the type and quality of evidence for mortality outcomes

No of Studies	Design	Mortality outcome*	Consistency	Generalizability (location)	Relative Risk (95% CI)	Grade	Comments
3	prospective cohort studies	All causes, among all live births	marginal heterogeneity from meta analysis (p=0.076); all studies show a benefit	South Asia, West Africa	0.56 (0.40 – 0.79)		Random effects meta analysis
3	prospective cohort studies	All causes, among low birth weight babies	Q test for heterogeneity from meta analysis (p=0.585); two of three studies show a benefit	South Asia, West Africa	0.58(0.43 – 0.78)		Random effects meta analysis
3	prospective cohort studies	Infection-related causes, among all live births	Q test for heterogeneity from meta analysis (p=0.134); one of three studies shows a benefit	South Asia, West Africa	0.55 (0.36 – 0.84)		Random effects meta analysis
3	prospective cohort studies	Sepsis-specific mortality, among all live births	Q test for heterogeneity from meta analysis (p=0.138); all studies show a benefit	South Asia, West Africa	0.42 (0.23 – 0.74)		Random effects meta analysis
3	prospective cohort studies	Birth asphyxia-specific mortality, among all live births	Q test for heterogeneity from meta analysis (p=0.887); zero of three studies show a benefit	South Asia, West Africa	0.50 (0.23 – 1.12)		Random effects meta analysis
2	prospective cohort studies	Prematurity-specific mortality, among all live births	Q test for heterogeneity from meta analysis (p=0.418); one of two studies show a benefit	South Asia, West Africa	0.56 (0.30, 1.02)		Random effects meta analysis

were not prospective were ranked as low if they estimated the relationship, but were excluded if they lacked this information.

The morbidity-focused data and/or presented analyses were of insufficient quality to achieve a HIGH quality rating, thus our meta- analysis does not include quantitative estimation of the possible protective benefits of early initiation of breastfeeding associated with the reduction in morbidities. Therefore, we present these results qualitatively with main conclusions and comments as supportive evidence for the overall benefit of early breastfeeding. Specific morbidities included in this qualitative presentation include neonatal hypothermia, malnutrition indicators (weight for age (WAZ), length-for- age (LAZ), and weight-for-length (WLZ)), neonatal weight loss, omphalitis, hypoglycemia, and diarrhea (persistent and acute diarrhea). Several studies were rated as MEDIUM quality according to the criteria; however they were not targeting the same morbidity and thus could not be combined for a meta-analysis assessing the association between early initiation of breastfeeding and specific morbidities.

According to CHERG standards, we abstracted measures of effect as well as 95% confidence intervals from all studies with a high ranking. In studies where relative risk (RR) was not the reported measure, authors were contacted and the adjusted relative risk measures were recalculated for use in this meta-analysis. We conducted a random-effects meta-analysis for a number of mortality-based outcomes:

1. Deaths from all causes within 28 days of birth among all babies surviving to 48 hours; Analyses were conducted a) among all live births; b) among babies <2500 grams at first weight measurement; and c) among babies exclusively breastfed.
2. Deaths from specific causes within 28 days of birth among babies surviving to 48 hours. Causes included a) "infection" (a more general non-specific categorization term including sepsis, meningitis, pneumonia, tetanus, diarrhea, dysentery, or other infectious diseases), b) sepsis-specific, c) birth asphyxia, and d) complications of premature delivery. Not all specific causes were available from each study.

The overall estimate for each outcome was calculated using the standard DerSimonian and Laird method with inverse variance weights.[16] These analyses were conducted using the user-written *metan* suite of commands available in STATA version 11.0 (Stata Corp., College Station, TX).

Results

Our search identified 2921 papers, with an additional 26 studies identified by snowball searching in which the relevant citations identified in full-review articles were retrieved and screened if applicable (Figure 1). After initial title and abstract screening, 291 articles were identified to have information relevant to time to initiation of breastfeeding and relevant outcomes. From the full article review of these 291 articles, 48 were evaluated to have low, medium or high quality data fitting the criteria for abstraction. Of these 48 articles, 30 were not suitable for data abstraction: 1 was a duplicate; 3 were erroneously approved for abstraction but did not fit criteria; 1 was not able to be retrieved for abstraction; 1 was a review of breastfeeding improvements to reduce neonatal mortality; 22 presented data on either time to initiation of breastfeeding and neonatal morbidity or mortality, or both, but did not present primary data and a direct estimate of the association between our exposure of interest and a morbidity or mortality outcome; and 2 did not focus on neonatal outcomes when assessing time to breastfeeding initiation.[17,18] After exclusions, the final set of included publications totaled 18 (from 14 distinct studies)and included 11 prospective cohort analyses[11,19-28] (7 distinct studies), 3 unmatched case-control studies,[29-31] 2 cross-sectional surveys,[32,33] 1 matched case-control,[34] and 1 randomized trial.[35] Data for these studies were collected in South Asia (6 studies, n=8 included publications), sub-Saharan Africa (6 studies, n=8 included publications), Northern Africa (n=1) and Europe (n=1).

1. Breastfeeding initiation time and mortality outcomes

Three secondary analyses of data collected within the context of large cluster-randomized trials of maternal (vitamin A supplementation)[36] and neonatal interventions (vitamin A supplementation,[37] chlorhexidine skin[38] and cord cleansing)[39] examined timing of breastfeeding initiation and mortality outcomes; each trial included >10,000 live births. Table 2 presents the study-specific estimates and 95% confidence intervals for the association between timing of breastfeeding and all-cause mortality among all infants and among the subgroup of

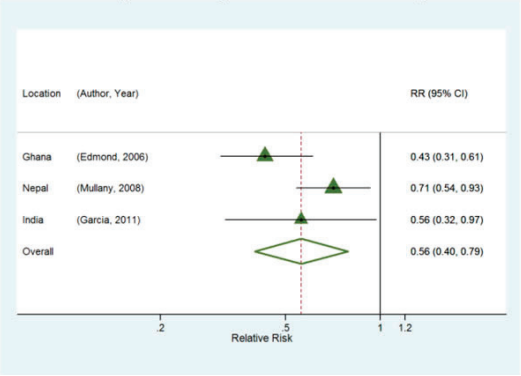

Figure 2a: Combined estimates of the association between early breastfeeding and all-cause mortality within 28 days, among live births surviving at least 48 hours.

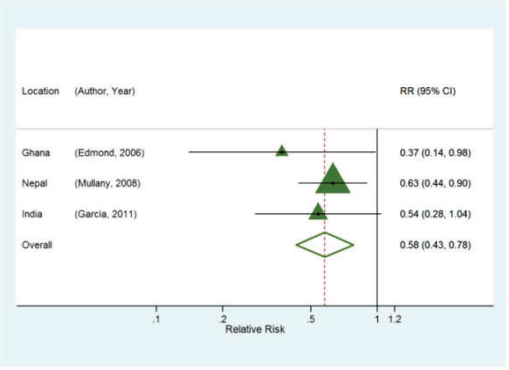

Figure 2b: Combined estimates of the association between early breastfeeding and all-cause mortality within 28 days, among low birth weight babies surviving at least 48 hours.

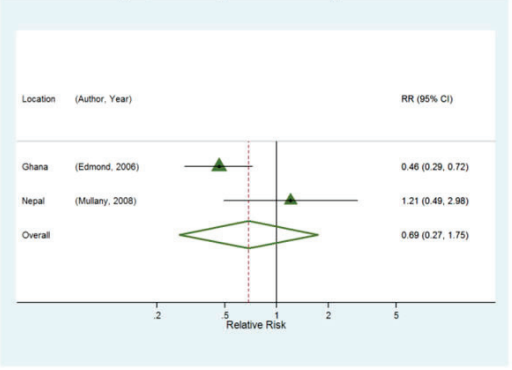

Figure 2c: Combined estimates of the association between early breastfeeding and all-cause mortality within 28 days, among exclusively breastfed babies surviving at least 48 hours

infants that were low birth weight (<2500 g), while study-specific estimates for the association with specific causes of death are summarized in Table 3. A summary of the combined estimates is provided in Table 4. For each study and for each outcome, analyses were restricted to deaths occurring after 48 hours, and adjusted for low birth weight, gestational age, and other confounders (these varied by study).

1a. Association with deaths from all causes

All three studies individually estimated a protective association between early initiation of breastfeeding and all-cause neonatal mortality among babies surviving the first 48 hours; the combined estimate of association indicated 44%(RR=0.56 [95% CI: 0.40 – 0.79]) lower risk of death. The overall estimate of

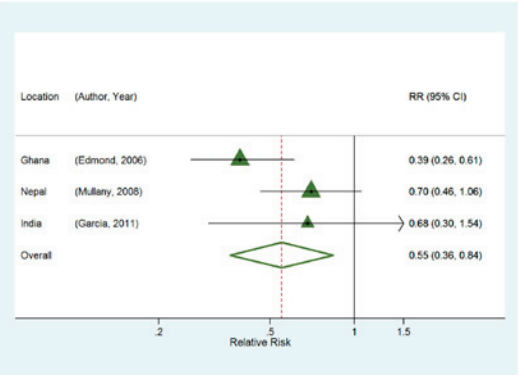

Figure 3. Combined estimates of the association between early breastfeeding and infection-related mortality outcomes within 28 days, among all live births surviving at least 48 hours.

association between breastfeeding initiation time and all-cause mortality among low birth weight babies demonstrated a 42% (RR=0.58 [95% CI: 0.43 – 0.78]) lower risk. When analysis of the association was restricted to babies that were exclusively breastfed (available for two studies only: Nepal, Ghana), study-specific estimates were substantially different, and overall there was no evidence of a protective benefit of early breastfeeding (RR=0.69 [95% CI: 0.27 – 1.75]). The study conducted in Ghana showed the greatest reduction in risk among all babies, among low birth weight babies, and among those exclusively breastfed. Forest plots for these analyses are found in Figures 2a, 2b, and 2c, respectively.

1b. Association with deaths from specific causes

For the association between early breastfeeding initiation and infection-related mortality, the magnitude was similar to the all-cause mortality estimates (both overall and among low birth weight babies). The risk of death was 45% (RR=0.55 [95% CI: 0.36 – 0.84]) lower among those breastfed early (Figure 3). When infection-related deaths were restricted to those classified in the individual studies as "sepsis" or "septicemia," the risk of death was 58% (RR=0.42 [95% CI: 0.23 – 0.74]) lower (Figure 4a). Early initiation of breastfeeding was not associated with birth-asphyxia specific deaths (RR=0.50 [95% CI: 0.23 – 1.12], Figure 4b) or deaths due to complications of prematurity (RR=0.56 [95% CI: 0.30-1.02], Figure 4c).

Due, in part, to inconsistent definitions of early breastfeeding and varying presentation of data (e.g., reporting of time to initiation of breastfeeding not standardized, original data not available in publication), zero studies that examined the relationship between early breastfeeding and specific morbidities ranked as HIGH quality (Table 5). Nevertheless, several studies ranked as MEDIUM, demonstrating a protective effect of early breastfeeding on neonatal morbidities including reduced weight loss and hypothermia. For example, a matched case-control study in Turkey reported that infants with a weight loss of ≥10% (3.39 ±2.37h) initiated breastfeeding later than those who lost <10% (2.14 ±1.31h) after controlling for birth weight, gestational age and reverse causality.[31] This protective effect of early initiation of breastfeeding on reduced weight loss was also identified in a prospective case cohort study in Zaire (i.e. Democratic Republic of Congo).[23] Yet, a number of small LOW quality studies found inconsistent associations between early breastfeeding and longer-term nutritional-indicators.[29,32,33] A prospective cohort study in Nepal (ranked as MEDIUM) reported an association between early initiation of breastfeeding and

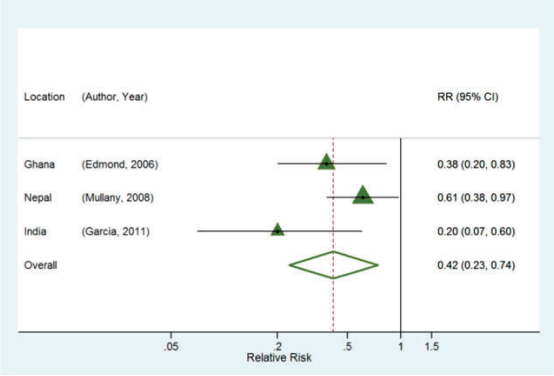

Figure 4a: Combined estimates of the association between early breastfeeding and sepsis-specific mortality outcomes within 28 days, among all live births surviving at least 48 hours.

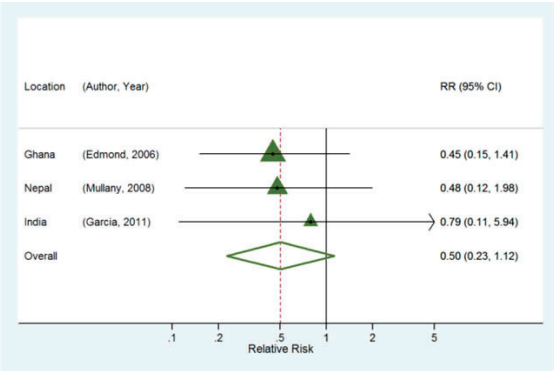

Figure 4b: Combined estimates of the association between early breastfeeding and birth asphyxia-specific mortality within 28 days, among all live births surviving at least 48 hours.

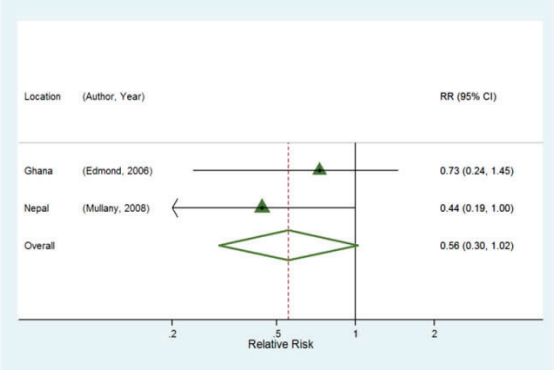

Figure 4c: Combined estimates of the association between early breastfeeding and premature-specific mortality within1c. Breastfeeding initiation time and morbidity.

lower incidence of neonatal hypothermia, after adjustment for confounders (prevalence rate ratio of 0.84 [95% CI: 0.77 – 0.93]).[27] In a sub-analysis of the Nepal dataset, the authors did not detect an association between early breastfeeding and signs of omphalitis.[25] A smaller prospective study in Zanzibar supported the association between early breastfeeding (within 1 hour) and lower rates of moderate/severe omphalitis (RR=0.29 [95%CI: 0.11 – 0.74]). [26] A small prospective cohort study of breastfeeding practices in Egypt reported lower rates of diarrhea among babies breastfed within 72 hours of birth. [19] While that study adjusted for reverse causality (i.e. infants with major congenital abnormalities and/or illnesses requiring hospitalization were excluded), low birth weight, gestational age and time intervals between birth and 72 hours after birth were not accounted for in the analysis. Finally, a study conducted in Malawi that randomly allocated the exposure of interest (i.e. breastfeeding initiation immediately after delivery) found that significantly fewer neonates that breastfed earlier had a temperature below <36.5°C the day after delivery.[35]

1d. Summary of the evidence for intervention effects

To report the evidence of the neonatal mortality outcomes into an estimate of effectiveness of reducing cause-specific mortality, we applied the standard CHERG rules for generating estimated intervention effects for the use of the intervention in Lives Saved Tool (LiST). These rules are used as guidelines in the review to determine whether the evidence of effect resulting from the review justifies inclusion of the intervention in LiST. Rule 2 applies stating "if there is high- or moderate-quality evidence of effect on cause specific mortality…Then use the mortality effect."[14] The included studies provided strong evidence of association with statistical results from the three meta-analyses each contributing pooled estimates with p values of <0.001. However, due to the fact that these pooled estimates are based on observational studies rather than RCTs, the meta-analysis received a moderate quality of evidence score (See Figure 5).

Discussion

Our data presented provides support for the protective effect of early breastfeeding initiation on death within the first 28 days, including all-cause mortality, deaths from infections, and deaths among low birth weight babies. We report a 44% (95% CI: 20 – 61%) lower risk of all-cause mortality within 28 days among live births surviving the first 48 hours of life, based on 3 prospective case cohort studies. Our findings are consistent with an additional small case control study with a long retrospective recall period, which estimated the odds of early breastfeeding among babies dying after day 1 were 87.0% lower than among survivors.[31] Deaths from all causes among low birth weight babies (42% lower [95% CI: 22 – 57%]) were also substantially lower among babies breastfed within 24 hours, but the magnitude and statistical strength did not differ from the overall result; this observation is true for both the combined estimate and for individual studies. Thus, while there is little evidence that the relative impact on mortality might differ between low birth weight and normal weight babies, the absolute benefit in terms of deaths averted through improved coverage of early breastfeeding would be greater among low birth weight babies, given higher underlying mortality risk.

The analyses of specific cause of death assist in our understanding of potential mechanisms by which early initiation may improve health outcomes among newborns. The association between breastfeeding initiation and the more general categorization of infection-related deaths was similar (RR=0.55) to that observed for all-cause mortality (RR=0.56); there are a number of explanations for this. One possible reason is that the verbal autopsy method used in these community trials does not always optimally classify cause of death, especially among newborns, as signs are often indistinguishable and/or overlapping among various causes. The more potential classifications that are grouped into a large categorization such as "infection-related deaths," the greater the potential for the inclusion of babies with true causes that are not protected through early breastfeeding. The greater magnitude association between initiation time and the subset of infection related deaths that were sepsis-specific (RR=0.42) provides some support to this claim. Another possibility is

Table 5 Summary of included studies presenting estimates of association between early breastfeeding initiation and morbidity outcomes

Study, Location	Sample Size	Study Design	Def of BF Exposure	Comment/Conclusions	Grade
Malnutrition WAZ					
Appoh [29], Ghana, facility	110	case-control	early vs. late	Reported an association between early breastfeeding initiation and a reduction in underweight children	LOW
Kumar [33], India, community	217	cross sectional survey	<6h vs. >6h	Reported an association between early breastfeeding initiation and a reduction in underweight children	LOW
Malnutrition WLZ					
Engebretsen [32], Uganda, community	723	cross sectional survey	<2h vs 2-24h<2h vs>24h	There was no statistically significant relationship comparing >24hr&<24 hours to <2hours (reference)	LOW
Kumar [33], India, community	217	cross sectional survey	<6h vs. >6h	The infant feeding practices studied were not significantly associated with wasting	LOW
Malnutrition, LAZ					
Engebretsen [32], Uganda, community	723	cross sectional survey	<2h vs 2-24h<2h vs>24h	There was no statistically significant relationship comparing >24hr&<24 hours to <2hours (reference	LOW
Kumar [33], India, community	217	cross sectional survey	<6h vs. >6h	Reported a significant association between early breastfeeding initiation and reduction in stunting	LOW
Early Weight Loss					
Enzunga [23], Zaire, facility	330	prospective cohort	early vs. late	Reports a direct relationship between the delay in initiation of breast-feeding and subsequent weight loss	LOW
Caglar [34], Turkey, facility	90	prospective matched case control	mean time to bf initiation	Infants with a weight loss of ≥10% were significantly more likely to have received their first breastfeeding later than controls	MEDIUM
Diarrhea					
Badruddin [30], Pakistan, mixed facility/ community	265	case-control	early vs. late	Reported a significant higher likelihood of late breastfeeding in cases (i.e. those with acute and/or persistent diarrhea)	LOW
Clemens [19], Egypt, community	198	prospective cohort	<72h vs. >72h	Reported a significant association between early breastfeeding initiation and reduction in diarrhea in the first six months of life	LOW
Acute Diarrhea					
Badruddin [30], Pakistan, mixed facility/ community	265	case-control	early vs. late	Reported a significant higher likelihood of late breastfeeding in cases (i.e. those with acute diarrhea)	LOW
Persistent Diarrhea					
Badruddin [30], Pakistan, mixed facility/ community	265	case-control	early vs. late	Reported a significant higher likelihood of late breastfeeding in cases (i.e. those with persistent diarrhea)	LOW
Omphalitis					
Mullany [26], Zanzibar, community	1653	prospective cohort	<1h vs. >=1h	Risk of omphalitis was 71% lower among babies breastfed within 1 hour	MEDIUM
Mullany [25], Nepal, community	17,198	prospective cohort	early vs. late	There was no statistically significant evidence to suggest that early breastfeeding initiation is protective against omphalitis	MEDIUM
Hypoglycemia					
Sasidharan [28], India, hospital	604	prospective cohort	early vs. late	Reported a significant association between early breastfeeding initiation and reduction in hypoglycemia	LOW
Hypothermia					
Mullany [27], Nepal, community	23,240	prospective cohort	early vs. late	The adjusted prevalence rate of hypothermia was 16% lower among babies for whom bf was initiated w/in 24hours	MEDIUM
Van den Bosch [35], Malawi, facility	160	randomized trial	Immediate vs. mother's choice of initiation time	Reported a significant association between early initiation and a reduction in low body temperature	LOW

that early breastfeeding initiation might additionally provide protection against some non-infectious causes of death, despite the current analyses not providing clear statistical evidence of such protection. Study-specific and combined estimates for birth asphyxia and deaths due to preterm complications (when available) were lower than 1.0; in the case of prematurity, the result was marginally statistically significant (p=0.06, RR=0.56 [95% CI: 0.30 – 1.02]). Furthermore, these analyses excluded deaths that occurred prior to 48 hours in an effort to minimize or eliminate reverse causality. Since the majority of deaths from these causes (preterm complications and birth asphyxia) occur within this immediate postpartum period, this effort to reduce

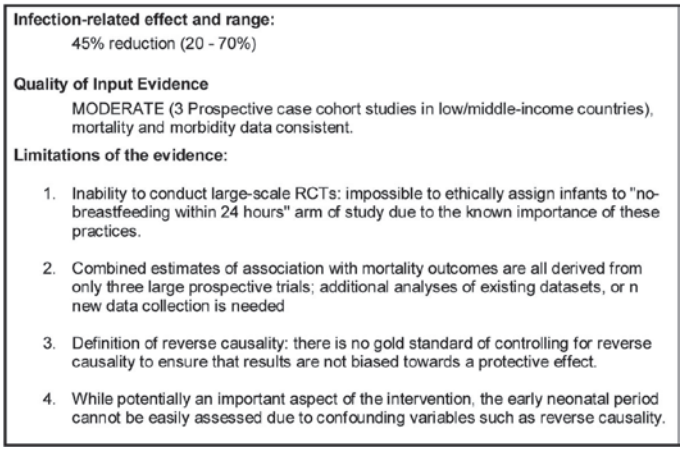

Figure 5. Infection-related mortality effect and quality grade of the estimate for the effect of early initiation of breastfeeding.

reverse causality bias may also obscure some benefit in this group. In particular, the possibility of an association should not be disregarded for deaths due to preterm complications. Early breastfeeding is an integral part of kangaroo-mother-care, which has been shown to reduce mortality among hospitalized preterm babies.[40]

The observed reduced mortality risk among babies breastfed early might be due to a number of factors. By displacing prelacteals, early initiation of breastfeeding can reduced risk of infections by decreasing the ingestion of infectious pathogens,[19] and early milk is colostrum-rich, thus elevating exposure to immunoglobulins and lymphocytes that stimulate the humoral or cell-mediated immune system.[41-43] Through priming of the gastrointestinal tract, early breastfeeding can decrease intestinal permeability and the likelihood of translocation of infectious pathogens.[44,45] Further, skin-to-skin contact between the maternal-infant dyad may also stimulate the mucosa-associated lymphoid tissue system.[46,47]

Our review of the literature includes a summary of analyses of neonatal or early infant morbidities. While these indicate some additional support for the potential benefit of early initiation, the studies are generally small in total size, do not adequately account for reverse causality, are inconsistent in the handling of important confounders such as gestational age or low birth weight, and, in some cases, are retrospective in design. The trend in Table 5 toward a protective association of early breastfeeding across multiple morbidities provides some support for the relationship, but the lack of high-quality analyses warrants caution and indicates a need for additional high-quality research in the area.

There are numerous limitations to the current review; these limitation results in a moderate rating of input evidence per CHERG guidelines (Box 1). First, we have only three main studies providing data for the analyses of mortality outcomes. There are some strengths to these studies, including multiple regions (South Asia and West Africa), prospective data collected in high-quality community-based randomized trials, and large sample size. However, despite consistent approaches to handling reverse causality (including removal of early deaths, and accounting for health status of baby), and adjustment for confounding, there remains the possibility of residual confounding and continuing reverse causality bias. A further limitation to interpretation arises from the weakness of the cause-of-death data. Individual studies used different verbal autopsy tools, definitions, and approach to classification (i.e. hierarchical vs. multiple causes, physician-adjudicated vs. computer-algorithm, etc.). The broadly defined categorization of "infection-related" deaths was associated with early breastfeeding, but may be subject to greater risk of misclassification of true cause. Within this group, neonatal sepsis was the predominant cause; when restricted to such deaths, the magnitude of association was increased, but statistical strength decreased, given smaller numbers. While both Africa and South Asia are represented, the current analyses are not sufficiently diverse, and further research from more countries is needed. The majority of the papers presented in this article were presented qualitatively due to the low quality rating as many of the studies did not account for major sources of bias that might incorrectly increase the perceived benefit of early breastfeeding practices on reduced infant and neonatal morbidity and mortality.[15] Further, many of the studies with low quality ratings published raw data or estimates in a form insufficient for meta-analysis, reducing further the ability to qualitatively or quantitatively compare studies assessing similar morbidity outcomes.

Finally, our review does not sufficiently cover other critical aspects of breastfeeding practices and potential impact on neonatal outcomes. These aspects include provision of colostrum, provision of prelacteals, and different patterns of breastfeeding ranging from mother's breast milk only ("exclusive"), to the provision of prelacteals (including, among others, water, water-based fluids, or milk-based fluids) followed by exclusive breastfeeding (sometimes termed "predominant"), to other breastfeeding patterns including complementary feeding to varying extent (sometimes termed "partial"). Given the strong correlation between timing of breastfeeding and pattern of breastfeeding, treating these as distinct interventions with separate and independent impact likely oversimplifies this interaction. For example, in rural Nepal, the odds of establishing an exclusive breastfeeding pattern were 8.1 times higher among babies breastfed early than those initiating after 24 hours.[11] The association between early breastfeeding and all-cause mortality among babies surviving to 48 hours was no longer significant when restricted to those that were exclusively breastfed, but study-specific estimates were inconsistent, and data were only available from two studies. While it is not yet possible to conclude an independent benefit of early initiation of breastfeeding among exclusively breastfed infants, early initiation might substantially increase exclusive breastfeeding especially in settings where the most likely deviation from exclusivity occurs through the provision of prelacteals in the first hours after birth.

Thus, teasing out the complex interactions between timing of breastfeeding and these patterns is not straightforward, especially given the limited number of datasets available. The benefits of colostrum are well documented; is the apparent protective effect of early breastfeeding initiation conferred by the earlier and more frequent exposure to colostrum? If attributable to some extent, how much so? To what extent do the apparent survival and health advantages of early breastfeeding work through other mechanisms such as improved thermal status conferred through contact with mother, or improved nutritional or immunological status? What role does early breastfeeding play in establishing medium to long-term positive breastfeeding patterns, including exclusivity? To answer these and other questions, further efforts in this domain require a

larger pool of high-quality data to better assess the independent or combined effects of various aspects of breastfeeding practice on neonatal outcomes. The LiST Tool currently includes "breastfeeding promotion" and current data are insufficient to include early breastfeeding as an independent, additional intervention.

Data from randomized controlled trials are not and will not be available, as it would not be ethical to randomize infants to a delayed initiation of breastfeeding. However, our understanding of the magnitude and extent of the protective effects of early initiation of breastfeeding would be greatly advanced through further analyses of existing datasets, and/or the inclusion of high quality, prospective measurement of timing of breastfeeding (and other feeding practices) and neonatal outcomes in current or planned large scale epidemiological studies. Such efforts should be carefully designed and conducted, and include accurate characterization of outcomes (including time and cause of death) and adequate measurement of potential confounders in order to mitigate methodological problems that otherwise substantially limit interpretation of the association between breastfeeding and neonatal health.

Conclusions

This literature review and meta-analysis emphasizes the importance of early breastfeeding initiation for the reduction of risk of infant and neonatal morbidity and mortality. These findings support a recommendation of early initiation of breastfeeding as an intervention to reduce neonatal mortality and morbidity in low and middle income countries. Priority research gaps include the need for additional high quality studies on the association with mortality risk, with further clarity of the specific causes, as well as improved quality studies assessing the protective effects against morbidities. We also need a better understanding of the relationship between early breast feeding initiation and establishment and maintenance of good breastfeeding patterns. We encourage continued research to further strengthen the recommendation for promotion of this intervention and to increase the accuracy of the estimate of impact.

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Strengths and Weaknesses of Parent-Staff Communication in the NICU: a Survey Assessment

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Abstract

Background: Parents of infants hospitalized in the neonatal intensive care unit (NICU) find themselves in a situation of emotional strain. Communication in the NICU presents special challenges due to parental stress and the complexity of the highly technologized environment. Parents' need for communication may not always be met by the NICU staff. This study aimed to describe strengths and weaknesses of parent-nurse and parent-doctor communication in a large level III NICU in Sweden in order to improve our understanding of parents' communication needs.

Methods: Parents were asked to complete a survey consisting of sixteen questions about their experiences of communication with nurses and doctors in the NICU. In each question the parents evaluated some aspect of communication on a five- or six-point Likert scale. They also had the opportunity on each question to comment on their experiences in their own words. Data were analyzed using IBM SPSS Statistics 20.0 and qualitative manifest content analysis.

Results: 270 parents (71.4%) completed the survey. Parents generally rated communication with the staff in the NICU positively and appreciated having received emotional support and regular information about their child's care. Although a large majority of the parents were satisfied with their communication with doctors and nurses, only about half of the parents felt the nurses and doctors understood their emotional situation very well. Some parents would have desired easier access to conversations with doctors and wanted medical information to be given directly by doctors rather than by nurses. Parents' communication with the staff was hampered when many different nurses were involved in caring for the infant or when the transfer of information in connection with shift changes or between the maternity ward and NICU was poor. Parents also desired to be present during doctors' rounds on their infant.

Conclusions: Training both doctors and nurses in communication skills, especially in how to meet parents' emotional needs better, could make communication at the NICU more effective and improve parental well-being. Creating a framework for the parents of what to expect from NICU communication might also be helpful. In addition, our results support the use of primary nurse teams to improve continuity of care and thereby promote successful communication.

Background

The parents of infants hospitalized in the neonatal intensive care unit (NICU) find themselves in a situation of emotional strain and potential crisis.[1-5] Being separated from their child is painful,[4-7] the hospital environment is unfamiliar[1,5,8,9] and parents are dependent on doctors and nurses to be able to cope with their situation[10,11] and familiarize themselves with the care of their child.[5,6,12] Good communication between parents and staff is therefore an essential part of the support offered to parents in the NICU. As previous studies have shown, parents whose children are being cared for in the NICU feel the need not only to understand the technical aspects of care, but also to have opportunities to discuss their experiences and emotions with staff members.[10,11] Parents feel supported by emotional responsiveness to their needs on the part of staff [6,11,13-15] as well as by being continuously informed about their child's state of health and treatment.[5,9,10,16,17] Parents' need for communication, however, is not always met by the NICU staff,[1,5,10,14,18,19] and staff may not be aware of communication problems in the same way as parents.[14,20] When parents feel dissatisfied with their communication with staff, their stress and anxiety increase[1,14,21] and they find it more difficult to establish a close relationship to their child.[1,22,23]

Parent-provider communication in the NICU presents special challenges due to parental stress and the complexity of the highly technologized environment.[10,24] The purpose of communication between staff and parents in NICU is not only to inform the parents about their child's medical condition and treatment; the doctors and nurses must educate the parents as well and invite them to participate in decision-making and the care of their child. The staff must use their communication skills to understand and support the parents in their emotional situation in NICU.[25] The purpose of the present study was to describe strengths and weaknesses in parent-nurse and parent-doctor communication, in order to improve our understanding of parents' needs in this area.

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Table 1 Characteristics of infants whose parents participated in the study

Variable	Number (%)	Median/ mean (SD)	Range
Gestational Age (weeks)		35/35 (5.0)	23–43
Extremely preterm birth (<28 weeks)	23(13.6)		
Moderate preterm birth (28+0 - 33 weeks)	27 (16.0)		
Preterm birth (33+1 - 37 weeks)	53 (31.4)		
Term birth (> 37 weeks)	66 (39.0)		
Total	169 (100)		
Birth weight (grams)		2463/2527 (1132)	535–5150
< 1000	20 (11.8)		
1000-1499	16 (9.5)		
1500-2499	49 (29.0)		
>2500	84 (49.7)		
Total	169 (100)		
Length of stay in the NICU (days)		6.0/14.9 (22.6)	1–116
1-2.5	23 (13.8)		
3-7.5	86 (51.5)		
8-14.5	23 (13.8)		
15-29.5	10 (6.0)		
> 30	25 (15.0)		
Total	167 (100)		
Discharge to			
Home without neonatal home care	53 (31.6)		
Home with neonatal home care	10 (6.0)		
Newborn Nursery	18 (10.7)		
NICU level II at other hospitals	79 (47.0)		
Pediatric ward at the same hospital	8 (4.8)		
Total	168 (100)		
Number of families with singletons or multiples			
Singletons	141 (91.0)		
Twins	13(8.4)		
Triplets	1 (0.6)		
Total	155 (100)		

Methods

Design

In order to describe different aspects of strengths and weaknesses in parent-nurse and parent-doctor communication in the NICU a survey instrument was used. Parents rated their experiences of communication in the NICU on a Likert scale and described their experiences in freely worded answers. The questions in the survey instrument were based on articles[10,11,25] delineating good communication in the NICU as satisfying the following conditions: doctors and nurses are available for conversations with the parents (questions 2 and 10); the parents' questions are answered (questions 3 and 11) and these answers are easy for them to understand (questions 4 and 12); the instructions/information to the families are given in such a way that parents can understand their child's medical condition and care and participate in decision-making concerning their child (questions 5 and 13); nurses and doctors understand the parents' emotional situation (questions 6 and 14); finally, nurses and doctors encourage the parents to participate in the care of their infant (questions 7 and 15). In addition, the parents also rated how satisfied they were with their communication with nurses and doctors in general (questions 1 and 9). They were also asked whether they felt something had been missing in their communication with the staff (questions 8 and 16).

Setting

The study was conducted over the course year at the Level III NICU[26] of a university hospital that treats about 1,000 newborns per year, including extremely premature and critically ill infants transported from other regional hospitals. The NICU had a high turnover of patients, often leading to a high workload for doctors and nurses. When the child's medical condition was sufficiently stable, he/she was transferred to a level II neonatal unit or was discharged home. The NICU has 22 beds divided into four rooms (two intensive care rooms and two intermediate care rooms) and a staff of 120, including doctors, registered nurses and nursing assistants. During office hours 4-5 doctors, including 2-3 attendings, 1-2 neonatal fellows, and 0-1 pediatric residents, work at the NICU. Each doctor is on service for a period of two to three weeks. After making rounds at the NICU, the doctors make rounds at the normal newborn nurseries. They also work at the follow-up clinic, teach medical students, and

Table 2 Distributions of parents' answers to survey questions about conversations with the NICU staff

Survey questions	Answers	Number (%)		P-value
		Nurses	Doctors	
1. How satisfied are you with the conversations you have had?	Very satisfied	190 (70.4)	167 (62.3)	0.03*
	Fairly satisfied	68 (25.2)	61 (22.8)	
	Neither satisfied nor dissatisfied	10 (3.7)	37 (13.8)	
	Fairly dissatisfied	1 (0.4)	2 (0.7)	
	Very dissatisfied	1 (0.4)	1 (0.4)	
	Total	270 (100)	268 (100)	
2. How easy has it been for you to communicate with nurses/doctors in the NICU?	Very easy	184 (68.4)	158 (59.2)	0.001*
	Fairly easy	74 (27.5)	75 (28.1)	
	Neither easy nor difficult	8 (3.0)	31 (11.6)	
	Fairly difficult	3 (1.1)	2 (0.7)	
	Very difficult	0 (0)	1 (0.4)	
	Total	269 (100)	267 (100)	
3. Have you received answers to your questions?	Yes	256 (95.2)	247 (92.5)	0.194
	No	13 (4.8)	20 (7.5)	
	Total	269 (100)	267 (100)	
4. Have the answers you have received been easy to understand?	Yes, always easy	114 (42.2)	143 (53.8)	0.071
	Yes, almost always easy	143 (53.0)	91 (34.2)	
	Neither easy nor difficult	8 (3.0)	22 (8.3)	
	No, not always easy	5 (1.9)	10 (3.8)	
	No, often not easy	0 (0)	0 (0)	
	No, almost never easy	0 (0)	0 (0)	
	Total	270 (100)	266 (100)	
5. Have the instructions/information that you have received about the care of your child been easy to understand?	Yes, always easy	151 (56.3)	155 (58.1)	0.253
	Yes, almost always easy	106 (39.6)	73 (27.3)	
	Neither easy nor difficult	6 (2.2)	31 (11.6)	
	No, not always easy	5 (1.9)	7 (2.6)	
	No, often not easy	0 (0)	1 (0.4)	
	No, almost never easy	0 (0)	0 (0)	
	Total	268 (100)	267 (100)	
6. How well do you feel that the staff you talked to in the NICU understood your emotional situation?	Very well	154 (57.0)	136 (51.5)	0.001*

have administrative and clinical meetings in the afternoons. This means that the number of physicians present at the unit is highly variable during office hours. From 5 p.m. to 8 a.m., one doctor is on call in-house at the NICU and another doctor is on call from home. Throughout the day, 5-6 registered nurses and 5-6 nursing assistants work at the NICU. The unit does not use primary registered nurse teams, neonatal nurse practitioners, or physician assistants.

Table 2 Distributions of parents' answers to survey questions about conversations with the NICU staff *(Continued)*

	Fairly well	84 (31.1)	59 (22.3)	
	Neither well not poor	28 (10.4)	61 (23.1)	
	Not very well	3 (1.1)	5 (2.0)	
	Not at all well	1 (0.4)	3 (1.1)	
	Total	270 (100)	264 (100)	
7. Did you feel the NICU staff encouraged you to participate in caring for your child?	Very well	178 (66.2)	143 (54.2)	0.0001*
	Fairly well	69 (25.7)	35 (13.3)	
	Neither well not poor	16 (5.9)	79 (29.9)	
	Not very well	6 (2.2)	4 (1.5)	
	Not at all well	0 (0)	3 (1.1)	
	Total	269 (100)	264 (100)	
8. Was there something you felt was missing in communication with NICU staff?	Yes	73 (27.2)	56 (21.2)	0.101
	No	194 (72.4)	208 (78.8)	
	Total	267 (100)	264 (100)	

Friedman's test was used to compare the distribution of answers regarding doctors and nurses. * Represents significant difference between the distribution of answers regarding doctors and nurses ($p<0.05$).

Participants

Parents of NICU patients were invited to participate in the study during the last days of their child's stay in the NICU. Parents who did not understand or could not make themselves understood in Swedish were excluded. The researcher responsible for recruiting parents for the study visited the NICU on 80 occasions evenly distributed over the year. Out of a total of 442 parents, 44 non-Swedish-speakers were excluded. Both parents of the same family were given the possibility of filling in the questionnaire. Of the 398 parents asked to participate in the study, 20 declined and the remaining 378 parents gave their informed consent.

Data collection

Parents were asked to complete a survey consisting of sixteen questions about their experiences of communication with nurses and doctors in the NICU respectively. In each question the parents evaluated some aspect of communication on a five- or six-point Likert scale. They also had the opportunity on each question to comment on their experiences in their own words.

To ensure that the questions were easy to understand, the survey instrument was tested through a pilot study in which 29 parents completed the survey in its entirety and were asked to critique its structure and wording.

The following data were collected on the infants: gestational age, birth weight, duration of stay in the NICU, number of newborns per family, destination after discharge from the NICU and (the last six months of the study) the sex of the parent answering the survey.

Data analysis

Data were analyzed using IBM SPSS Statistics 20.0.[27] Differences between parents' answers to questions regarding nurses and doctors, and differences between mothers' and fathers' answers were compared using Friedman's test.[27] Effect-size calculations were used to determine the clinical significance of the results. Based upon Cohen's suggestions, effect sizes of 0.2 to 0.5 have been regarded as being small, those of 0.5 to 0.8 as moderate and those of 0.8 or above as large.[28] A level of significance of less than 0.05 was considered statistically significant.

The free-response answers to the survey questions were transferred verbatim to Microsoft Excel files and inductively analyzed by qualitative manifest content analysis as described by Graneheim and Lundman.[29] Elements in the participants' descriptions of strengths and weaknesses in parent-nurse and parent-doctor communication were sorted into categories and subcategories within the two overarching domains designated as "strengths" and "weaknesses". Within each domain, category and subcategory, each respondent was counted only once irrespective of his or her total number of comments in that area. When given the opportunity to describe their experiences in their own words, most parents mentioned both strengths and weaknesses that they had found in their communication with NICU staff.

Results

Characteristics of parents and infants

Of the 378 parents who received the survey, 270 (71.4%) completed it. Collectively they had a total of 169 children in the NICU, whose characteristics are presented in Table 1. Most infants (70.4%) were either moderately preterm or term. The length of stay in the NICU varied from 1 to 116 days, but the majority (65.3%) stayed at the hospital between three days and two weeks.

Table 3 Distributions of parents' (n=226) descriptions of strengths and weaknesses of communication with nurses

Domains	n (%)	Categories	n (%)	Subcategories	n (%)
Strengths	204 (90.3)	Emotional support	180 (79.6)	Kind	67 (29.6)
				Understanding	52 (23.0)
				Took time	46 (20.3)
				Helpful	33 (14.6)
				Considerate	27 (11.9)
		Good information giving	131 (72.7)	Open and truthful	30 (13.2)
				Continuous information	28 (12.3)
				Gave answers to questions	28 (12.3)
				Gave good explanations	21 (9.3)
				Clear	20 (8.8)
		Professionalism	65 (28.7)	Competent	29 (12.8)
				Knowledgeable	29 (12.8)
				Confident	22 (9.7)
				Calm	18 (8.0)
				Took good care of the child	11 (4.9)
Weaknesses	118 (52.2)	Lack of emotional support	67 (29.6)	Lack of responsiveness	27 (11.9)
				Lack of focus on the parents' feelings	15 (6.6)
				Uninterested	13 (5.8)
				Unhelpful	11 (4.9)
				Unempathetic	10 (4.4)
		Poor information giving	76 (33.6)	Poor information	74 (32.7)
				Hard to get information	19 (8.4)
				Unclear	14 (6.2)
				No updates	14 (6.1)
				Different answers from different nurses	10 (4.4)
		Lack of professionalism	34 (15.0)	Incompetent	14 (6.2)
				Rude	13 (5.8)
				Seemed stressed	10 4.4)
				Left parent out of child's care	10 (4.4)
				Irritated	5 (2.2)
		Organizational problems	72 (31.9)	Lack of collaboration with maternity ward	38 (16.8)
				Lack of staff continuity	32 (14.2)
				Different attitudes of different nurses	23 (10.2)
				No nurse specially responsible for patient	10 (4.4)
				Poor information during shift changes	8 (3.5)

The number of parents who described their experiences of communication with nurses in their own words is reported. Each parent is counted only once for each domain, category and subcategory. The five most common subcategories are reported. n=number.

Both parents in families participating in the study were encouraged to answer the questionnaire separately. We collected information on the sex of the parents answering the questionnaire for the last 144 participants. Of these, 75 (52.0%) were mothers and 69 fathers (48.0%).

Answers to the survey questions

Distributions of parents' answers to survey questions about conversations with the NICU staff are shown in Table 2. Overall, parents rated communication in the NICU highly. A large majority of the parents stated that they were satisfied with their conversations with nurses and doctors and found it easy to communicate with nurses and doctors.

Almost all parents stated that they had received answers to the questions that they had from both nurses and doctors. In both cases, they felt that the answers were always or almost always easy to understand. Almost all parents also stated that the information and instructions that they had received were always or almost always easy to understand (95.9% for nurses, 85.4% for doctors).

Although a large majority of parents felt that the staff understood their emotional situation, only about half of the parents felt very well understood in this respect. Almost all the parents felt encouraged by the nursing staff to participate in the care of their infants; about 2/3 felt encouraged by doctors to do so.

In spite of mostly expressing satisfaction with various aspects of communication with NICU staff, many parents felt that something was lacking in communication with nurses (27.2%) and doctors (21.2%). The parents' freely worded comments gave us important information about the reasons for this dissatisfaction (see Tables 3 and 4).

The sex of the parent answering the survey was available for 70

Table 4 Distributions of parents' (n=206) descriptions of strengths and weaknesses of communication with doctors

Domains	n (%)	Categories	n (%)	Subcategories	n (%)
Strengths	133 (64.6)	Emotional support	87 (42.2)	Took time	27 (13.1)
				Nice	16 (7.8)
				Understanding	11 (5.3)
				Empathetic	9 (4.3)
				Listened	9 (4.3)
		Good information giving	111 (53.9)	Clear	65 (31.6)
				Gave good explanations	39 (18.9)
				Simple language	36 (17.5)
				Gave answers to questions	26 (12.6)
				Frequent, regular information	22 (10.9)
		Professionalism	22 (10.7)	Calm	17 (8.3)
				Knowledgeable	13 (6.3)
				Competent	11 (5.3)
				Confident	7 (3.4)
				Concerned about child's best	6 (2.9)
Weaknesses	153 (74.3)	Lack of emotional support	62 (30.1)	Didn't take time	21(10.2)
				Lack of responsiveness	20 (9.7)
				Lack of focus on parents' feelings	13 (6.3)
				Unempathetic	8 (3.9)
				Insensitive	7 (3.4)
		Poor information giving	100 (48.5)	Poor information	100 (48.5)
				Unclear	40 (19.4)
				Difficult language	24 (11.7)
				Information given via nurses	22 (10.7)
				Lack of continuous information	17 (8.3)
		Lack of professionalism	15 (7.3)	Seemed stressed	10 (4.9)
				Untruthful	5 (2.4)
				Insecure	3 (1.5)
				Awful	2 (1.0)
				Arrogant	1 (0.49)
		Organizational problems	72 (35.0)	Unavailability	71 (34.4)
				Lack of participation during rounds	18 (8.7)
				Different attitudes of different doctors	15 (7.3)
				Lack of staff continuity	13 (6.3)
				Lack of collaboration with maternity ward	8 (3.9)

The number of parents who described their experiences of communication with doctors in their own words is reported. Each parent is counted only once for each domain, category and subcategory. The five most common subcategories are reported. n=number.

Table 5 Results of the effect size calculations

Survey questions	Pearson's r coefficient	Effect size (Cohens' d)
1. How satisfied are you with the conversations you have had?	0.28	0.22
2. How easy has it been for you to communicate with nurses/doctors in the NICU?	0.33	0.23
6. How well do you feel that the staff you talked to in the NICU understood your emotional situation?	0.54	0.26
7. Did you feel the NICU staff encouraged you to participate in caring for your child?	0.28	0.37

*Effect sizes according to Cohen.
0.2-0.5=small.
0.5-0.8=moderate.
0.8 or above=large.

couples. For each couple, the mother's and father's answers were compared to each other. No significant differences were found ($p>0.05$).

Differences between nurses and doctors: effect size

Each parent's answers to survey questions on communication with nurses were compared with the corresponding answers concerning doctors (Table 2). Significant differences were found in several areas (Table 2, $p<0.05$).

Effect-size calculations were used to determine whether the statistical differences that were observed between parental ratings of communication with nurses versus doctors were clinically meaningful. Table 5 shows the values from the survey

questions used in the calculations and gives the results of the calculations. The results are based on the average from two means corrected for dependence between means using Morris and DeShon's equation 8. The effect sizes for the differences as measured by SRM (standardized response mean) were all low, indicating that even though these differences were statistically significant their clinical significance as measured by Cohen[28] was slight.

Parents' freely worded descriptions of their experiences

In the free-response part of the survey, 226 parents gave a total of 996 answers in their own words regarding their communication with nurses (median 5.3 comments per parent, range 1-8). Of 226 parents, 108 described only strengths, 22 only weaknesses and 96 both strengths and weaknesses in communication with nurses (Table 3). 206 parents described their communication with doctors in a total of 826 answers (median 4.0 comments per parent, range 1-8). 53 of these parents described only strengths, 73 only weaknesses and 80 both strengths and weaknesses in their communication with doctors (Table 4).

Qualitative manifest content analysis was used to classify these 1822 comments by 243 parents into two groups: those describing strengths in communication, with the subcategories of emotional support, good information giving and professionalism, and those describing weaknesses in communication, with the subcategories of lack of emotional support, poor information giving, lack of professionalism and organizational problems (Tables 3 and 4).

In order to highlight which specific strengths and weaknesses were perceived as most prevalent by the parents, we counted the number of parents who reported positive and negative experiences of communication with nurses/doctors in their own words. Each parent is counted only once for each domain, category and subcategory. The five most common subcategories are reported in Tables 3 and 4.

Strengths and weaknesses in communication

Emotional support

Nurses and doctors who gave emotional support to the parents were described as considerate, empathetic or helpful, nice or kind; they took time, showed understanding and were considerate (Tables 3 and 4). A larger number of parents described having received emotional support from nurses than from doctors (Tables 3 and 4).

"When I was sad and anxious they were there to listen or lay a hand on my shoulder" (parent of an infant treated for hypoglycemia describing communication with nurses). *"We didn't meet the doctors nearly as often as the nurses, so there wasn't as much of an emotional relationship with the doctors"* (parent of a moderate premature infant describing communication with doctors).

Some parents felt that doctors had showed understanding of their emotional situation by referring to himself/herself. *"Doctor X told us that she had children herself"* (father of a premature infant treated for necrotizing enterocolitis describing communication with doctors).

Parents' trust in the doctor's assessment of the medical situation of their child helped them feel reassured. *"When I wasn't sure whether my son would make it, I would ask Dr X if he was worried, because if he felt they had everything under control, I wasn't so worried anymore"* (parent of an extremely premature infant describing communication with doctors).

Lack of emotional support

Parents who felt that communication with NICU nurses and doctors had been marred by a lack of emotional support described the nurses and doctors as unempathetic, insensitive, or uninterested; they were felt to lack responsiveness or focus on the parents' feelings (Tables 3 and 4). Several parents mentioned that doctors who did not give emotional support failed to take time to talk to parents (Table 4).

"When I was tired and started to cry the response was just 'don't cry' without any other comment or asking why I was crying. I felt they were fairly brusque and uninterested, maybe they thought our baby was too healthy compared to other babies in the unit" (parent of an infant treated for infection describing communication with nurses). *"There was no time for anything but talking about the baby"* (mother of an infant treated for hypoglycemia describing communication with doctors). *"I don't feel that the doctors were so interested in understanding how we felt"* (parent of an infant treated for hypoglycemia describing communication with doctors).

Some parents described situations where they had felt that staff had not understood their emotional situation or met their need for support.

"The staff is so used to seeing children with catheters and lines that they forget how hard it is on parents" (parent of a moderate premature infant describing communication with nurses). *"When we were discharged we had a really hard time. Few staff members seemed to understand how hard it was and no one asked"* (parent of an infant treated for X syndrome describing communication with nurses). *"Only one doctor showed that she understood our situation, the others didn't. It is terrible if they can't or don't have the energy to understand"* (parent of an infant treated for hypoxia describing communication with doctors).

Several parents stated that they were worried and needed emotional support although they were aware that their infant was not very ill.

"Regardless of how sick the baby is, the parents have a hard time. Try to understand this and don't rank us according to the severity of the baby's condition" (parent of an infant treated for icterus describing communication with nurses). *"I am a physician myself, but in the NICU I was, "only a mother" and I was quite worried although our child was doing well. I would like to have vented my anxiety even if there was no real reason for it."*

Good information giving

Many parents appreciated having received regular information and good explanations about their child's care from both nurses and doctors and getting their questions answered (Tables 3 and 4). It made a difference to them when doctors gave them clear information, prepared them before examinations of their child and explained the results to them afterwards. Parents reported that communication with doctors was easier when the doctor used simple language (Table 4). Nurses' readiness and openness

in answering the questions parents had about their child's condition made parents feel well-informed (Table 3).

"They explained the procedures well and told us when they were changing something and why. We were also informed in advance about what they thought the next step would be" (parent of an infant treated for hypoglycemia describing communication with doctors). *"Most of them were open to our questions and what might have been silly worries"* (parent of an extremely premature infant describing communication with nurses).

Poor information giving

Many parents stated that they had been given poor or unclear information by nurses and doctors (Tables 3 and 4). Some parents had received different information from different nurses. Both nurses and doctors were often stated to have provided too little information (Tables 3 and 4).

"When I came up (to the NICU) one day after my C-section, no one took the time to explain what had happened. My daughter had been moved from a bed to an incubator and to CPAP treatment. SHOCK!" (mother of a premature infant describing communication with nurses).

Some parents said doctors had used medical jargon that was difficult to understand (Table 4).

"They throw terminology at you that you don't understand and are sometimes totally insensitive to the fact that it feels like a death sentence for your child when they come in and explain test results and then rush out again before the information has sunk in" (parent of an extremely premature infant describing communication with doctors). *"Too many medical terms and too many different answers to the same questions which makes you think they don't really know what they're talking about"* (parent of an extremely premature infant describing communication with doctors).

Some parents criticized the fact that they had received information via nurses rather than directly from the doctors (Table 4).

"Information should not go through several people, the doctors tell the nurses things but it would be better if doctors informed the parents directly" (parent of an extremely premature infant describing communication with nurses). *"Doctors communicated sometimes though the nurses and it felt that some information was lost"* (parent of an infant treated for infection describing communication with doctors).

Parents whose infants did not have severe diseases or stayed in the NICU for a short time felt that they did not have the possibility of talking with a doctor as much as they would have liked. However, these parents got the information they needed from the nurses instead.

"I am happy with the conversations I had but had wanted to have more conversations with doctors. I got information from the nurses" (parent of an infant treated for infection describing communication with doctors). *"It felt strange not to meet the doctors who make decisions about the treatment but it was OK because the nurses were good at communicating"* (mother of an infant treated for infection describing communication with doctors). *"I did not see the doctors much, but it was probably because our son "behaved himself" and just needed to grow"* (parent of a moderate premature infant describing communication with doctors).

Professionalism

Nurses and doctors who were competent, calm, confident, and knowledgeable were felt to be professional (Tables 3 and 4).

"I felt safe leaving my child with the staff" (mother of moderate premature infant describing communication with nurses). *"They were focused and stayed calm… Their confidence gave me hope and strength"* (parent of an infant treated for hypoxia describing communication with doctors).

Parents praised the fact that nurses had encouraged them to participate in the care of their child, which gave them the sense of being understood on an emotional level. Some parents stated that they had not discussed their own involvement in their child's care with doctors at all, but that this had been part of the nurses' job.

"They encouraged us to hold and nurse the child very soon after birth" (mother of a moderate premature infant describing communication with nurses). *"I don't feel the doctor was directly involved in this, it was more through the nurses. The doctor's job was more to evaluate how my daughter was doing and her development"* (parent of a premature infant describing communication with doctors).

Lack of professionalism

Overall, parents seldom commented on lack of professionalism in their freely worded comments (Tables 3 and 4). Some parents mentioned that nurses were incompetent, rude or stressed (Table 3). Some parents felt that doctors were stressed (Table 4).

Some parents found it hard to participate in caring for their child when they were not given enough practical instructions or when nurses left them out of decisions concerning the care of their child. Instead they had a feeling of being unneeded by their child or in the way. Those parents who did not receive sufficient information and guidance from nurses sometimes reported feeling that they were being excluded and not given the chance to take care of their child.

"As a parent you want to do as much as possible and be involved. It often felt as if he belonged to someone else" (mother of an extremely premature infant describing communication with nurses).

Some parents felt the staff sometimes underestimated their abilities which they found offensive.

"Since this wasn't my first child some instructions could feel insulting, as if I did not know how to hold a baby. Sometimes I got instructions without wanting or needing them" (mother of an infant treated for hypoglycemia, infection and icterus describing communication with nurses).

A few parents described situations where they felt it was best to follow the routines of the unit even if they as parents had another opinion.

"There were some who made you feel uncomfortable if you didn't follow their routines" (parent of a moderate premature infant describing communication with nurses).

Organizational problems

Organizational factors reported most often by parents as impairing communication with nurses included lack of collaboration with maternity ward, lack of staff continuity, and different attitudes of different nurses and not having a nurse especially responsible for the parents (Table 3). For parent-doctor communication, unavailability of doctors was the problem reported most often, followed by lack of parent participation during rounds, different attitudes of different doctors, and lack of staff continuity (Table 4).

"We lost our baby (twin) and had a meeting with the doctor about what had happened and his cell phone rang all the time, the staff wanted him. We felt really badly after the meeting, this shouldn't happen in these kinds of meetings" (mother of an extremely premature twins describing communication with doctors). *"The doctors have too many babies to take care of at a time. It would be better if there weren't so many patients, but thanks so much for all you have done for us"* (father of an extremely premature infant describing communication with doctors).

Poor continuity of the staff caring for the infant and communication failures between staff members impaired communication with parents. Informing the parents of changes in staffing and introducing the new nurse beforehand to the family might improve the transition, if continuity of staffing is not a possibility

"Continuity has been poor sometimes. It was hard to know who would be working when. Just when you were beginning to have confidence in someone they would go work somewhere else and not come back. I wish the staff had been better at letting us know when we would meet them next"(parent of an extremely preterm infant describing communication with nurses).

Some parents reported that defects in communication between the NICU and the maternity ward or in conjunction with shift changes resulted in communication problems between nurses and parents (Tables 3 and 4). A lack of collaboration between different staff members or units sometimes meant that parents themselves felt responsible for informing staff concerning their child's care.

"At the normal newborn nursery they told me to pump manually, but when I came to the NICU they said no, it's better to use the breast pump. Later when I went back to the newborn nursery they went on again about how I should pump manually and when I said they told me at the NICU to use the machine, they got angry" (mother of a moderate premature infant describing communication with nurses).

Another organizational factor was the fact that the NICU consisted of four large rooms with several patients in each of them. In order to ensure patients' privacy, parents were not generally allowed to be present during rounds. A feeling of being left out and insufficiently involved resulted when parents were not allowed to be present during rounds on their child.

"In general I'd like to be there during rounds on my child. The same way adult patients are present when the doctors round" (mother of an extremely premature infant describing communication with doctors). *"I really dislike the fact that they gave us very serious news concerning our child so that other parents could hear. It's extremely important to talk to parents in a separate room"* (mother of a premature infant treated for necrotizing enterocolitis describing communication with nurses).

Discussion

This large study consists of a quantitative and a qualitative analysis of strengths and weaknesses perceived by parents in their communication with doctors and nurses at the NICU. The quantitative analysis of parents' answers to survey questions revealed that parents were overall satisfied with their conversations with both nurses and doctors. They felt that the information that they received from the health care professionals was easy to understand. The majority of the parents also felt that both doctors and nurses understood their emotional situation and encouraged them to participate in the care of their infant. Although statistical analysis revealed that nurses received higher ratings in these two areas, the parents were not specifically asked to compare doctors with nurses in the questionnaire. Moreover, effect size calculations indicated that the differences between nurses and doctors were not clinically significant. In addition, although parents' communication with nurses and doctors overlaps to some extent, the professional groups are not in competition with each other. Instead, parents' communication with the two professional groups can be seen as complementary. For example, doctors are mainly responsible for informing the parents about the baby's medical condition and treatment, whereas nurses, who spend more time at the bedside, have more opportunities to support the parents emotionally and encourage them in their parental role.

It is well known from other studies about provider-patient communication that different patients have different information needs.[10,11,25] It is therefore also understandable that different NICU parents have different expectations about nurse-parent or doctor-parent communication. It is important for caregivers to ask the parents what they know and what questions they have.

The qualitative analysis of parents' free-response answers to survey questions describes both strengths (emotional support, good information giving, professionalism) and weaknesses (lack of emotional support, poor information giving, lack of professionalism, organizational problems) of communication between parents and staff in the NICU. Parents describe their experience in communication with nurses and doctors most by positive terms, but at the same time they noted many flaws in specific aspects of communication, as revealed by their comments in the survey. For example, a mother whose child was treated for seven weeks in the NICU for prematurity stated that she was fairly satisfied with the communication she had had with the nurses but then wrote in her own words that two nurses had been inconsiderate and offensive. Another mother, whose term baby spent a month at the NICU for an uncommon illness also, stated that she was fairly satisfied but wrote that staff had not always taken time to explain things and conversations had been rushed. We might ask why these mothers did not rate themselves as fairly dissatisfied rather than fairly satisfied. An explanation for this apparent discrepancy may be that parents tend to evaluate NICU care in positive terms because they are generally grateful for the care their child has been given, as previous studies have shown.[1,19] Another possible explanation is

that the answers to multiple-choice questions give an indication of parents' general impressions of communication in the NICU, while the free-response portion of the survey allowed them to focus on details of their experience. The use of complementary methods in communication research allowed a more nuanced picture to emerge than either method on its own would have.[30]

This study confirms that, as several previous studies have shown, an empathetic attitude on the part of staff makes a difference to parents' experience of communication in the NICU and to their relations with nurses[1,11,14] and doctors.[10,31] A good relationship between parents and staff, in turn, plays an important role in parents' satisfaction with neonatal care[6,14,16] as well as their relationship to their child. [12,23,32] Several studies have focused on the ethical dimension of communication in the NICU.[33-35] Parents of NICU patients may feel helpless and vulnerable and are, to a certain degree, dependent on staff to be able to establish a physically and emotionally close relationship to their child. This can be seen as implying an ethical responsibility on the part of staff to do their best to help parents in this stressful situation.[12]

Weiss et al.[17] have shown that availability of staff for conversations has a significant impact on parents' perception of staff as empathetic and understanding. A lack of contact between staff and parents, on the other hand, can reinforce parents' feelings of anxiety and exclusion. One probable reason why communication with nurses was described as a source of emotional support more often than communication with doctors is that nurses, because of the nature of their job, are more often physically present at the bedside and thus more available for emotional contact with families. The physical accessibility of nurses and the practical caregiving involved in their work may also explain why they were experienced as encouraging parents to be involved in caring for their child.

The NICU is staffed with more nurses than doctors per patient and the nurses have more opportunities to notice the needs of parents and to give them emotional support. But the number of nurses and shift changes can lead to problems in continuity. Lack of staff continuity was described by participants in the present survey as an impediment to effective information giving. Other studies have shown it to contribute to a sense of insecurity on the part of patients' families.[6,32]

The most important weakness in information-giving reported in this study was information that was too scanty or infrequent. Some parents complained that staff, especially doctors, used medical terminology that was hard to understand and that nurses gave information about their child's medical condition. Parents need to be sufficiently informed about their child's condition and treatment if they are to have confidence in the care their child is receiving and see their relationship to NICU staff as positive.[5,10,12] Parents who feel well-informed are satisfied with neonatal care[17,36] and feel involved in caring for their child.[18,36,37]

In family-centered care (FCC), parents are kept well-informed and involved to a high degree in the care of their child and decisions affecting the child.[38,39] FCC has been shown to result in improved collaboration between parents and staff, decreased stress and insecurity on the part of parents,[40] and their improved satisfaction with communication with doctors irrespective of the gravity of the child's condition.[37] NICU staff can affect the degree to which care is family-centered by inviting parents to be involved in caring for their child or by failing to do so. The flaws in information giving reported by some parents in this study may be an indication that care is insufficiently family-centered.

The most pronounced organizational problem revealed by this study was doctors' limited availability for discussions with parents. The parents wished to meet the doctor more often but understood that the doctors just did not have time for this. Kowalski et al. [31] have shown that parents of NICU patients, in particular those whose children are not gravely ill, feel they do not often meet the neonatologist. Nevertheless, parents were generally satisfied with their contacts with staff and trusted that the doctor would be available to talk to them if the child's condition worsened acutely. A study by Bramwell et al. [18] has shown that being present during rounds in the NICU enables parents to establish relationships with staff members and take part in discussions concerning their child. Parents in this study would have liked the opportunity of meeting the doctor during rounds.

One might expect that parents of very immature infants who have most medical problems and the longest duration of hospitalization would have more communication problems than fullterm infants with minor illnesses and a short hospitalization. However, analysis of our data stratified according to gestational age, birth weight, and duration of stay showed that the parents' answers were not dependent on these variables. It seems that independent of the infant's length of stay or birth weight or gestational age, parents are worried and stressed and need information and empathy from nurses and doctors as well as encouragement and support in their role as parents. Parents whose infants have most medical issues and a long length of stay also receive more attention and have more opportunities of communicating with the medical providers than parents of infants with minor illnesses. In addition, the background, previous experiences, and personality of the parents are likely to have an influence on their need for communication independent of the severity of the infant's illness or the length of stay or gestational age.

Results from this single-center study cannot be extrapolated to other centers with differently organized doctor-nurse teams. For example, the Swedish health care system does not include intermediate medical providers such as Advanced Practice Nurses (Neonatal Nurse Practitioners) or Physician Assistants, who are an essential part of the NICU team in some other countries, such as the United States. Another weakness of this study was that we excluded parents who did not speak or understand Swedish. We always use interpreters in our NICU when communicating with such families. Another study would be needed to address the communication needs and problems of these families.

Conclusions

This study can help the staff in the NICU to understand parents' experiences of communication better and thus form a basis for improving communication between parent and staff. Although a large majority of the parents were satisfied with their communication with doctors and nurses, only about half of the parents felt the nurses and doctors understood their emotional situation very well. Training both doctors and nurses in communication skills, especially in how better to meet parents' emotional needs, could make communication at the NICU more effective and improve parental well-being. Creating a framework for the parents of what to expect from communication in the

NICU might also be helpful. In addition, our results support the use of primary nurse teams to improve continuity of care and thereby promote successful communication.

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