



Perinatal
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Partner

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Warm, Pink and Sweet

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The unexpected happens and you have a preterm delivery in your centre. You have done your NRP best and the baby is looking good. However, the transport team is going to be awhile. What can you do to help the baby stay well while you wait for help? It has been said that when the team arrives they would like to find a baby who is 'warm, pink and sweet'. Attention paid to thermal management, oxygenation and glucose levels will go a long way to keeping the baby well. These aspects have been likened to a three-legged stool that will not work if one of the legs is lost. If the baby is cold for instance, the baby will likely also be hypoglycemic and have respiratory difficulty. The purpose of this article is to provide guidance around post-resuscitation management.

WARM

Normal newborn temperatures are in the range of 36.6-37° C. Most units are using the axilla temperature as a screen. Tympanic thermometers are not recommended in the newborn period. Rectal temperature taking is potentially dangerous and not routinely done. Remember that core temperature drops only when the baby's effort to maintain temperature production has failed; therefore, normal infant temperature does not rule out cold stress. The baby's temperature (heart rate and respirations) should be taken hourly for at least the first four hours, and then at least every four hours thereafter.

The baby will be cared for in an incubator or on a radiant warmer. There are pros and cons to each device. The radiant warmer allows quick access to the baby and ease of procedures. However, the radiant warmer increases the insensible water loss for the baby, and does not protect the baby from convective losses. The increased insensible water loss means that the infant's fluid requirements will need to be individualized.

Ideally, the nursery will be at least 27° C and the warmer will not be near drafts from cold air inlets, etc. If a radiant warmer is used, a skin probe must be placed to protect the baby from over-heating. The warmer then acts like a thermostat keeping the baby at the preset temperature of 36.6-37° C. The baby must be kept naked on the warmer. Covering the baby will prevent heat from getting to the infant. Similarly, when procedures are done, staff should try not to lean over the bed, as they will put the baby 'in the shade'. (The smell of burning hair will no doubt remind them!)

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Incubators reduce the risk of convective losses and insensible water loss and are preferred for tiny premature infants. They are more restrictive for procedures. Ideally, the incubators will be double-walled. If they aren't, a Plexiglas shield may be placed over the baby, or aluminum foil may be placed around three sides of the incubator, shiny side in. A neutral-thermal environment chart (fig. 1) is a MUST to guide staff in optimal incubator temperature settings. Again, don't assume that the baby is not cold stressed if the axilla temperature is normal. The baby may be working very hard to keep it that way and will eventually fail. When the baby's temperature is taken the incubator, temperature should be recorded as well.

Incubators are run 'dry' to prevent the growth of pseudomonas. The exception to this is the newer incubators that actually boil the water in the reservoirs.

PINK

Oxygen should be regarded as a drug and requires a physician order that includes the mode of delivery and the 'dosage' expressed in percent (%), or as a fraction of inspired oxygen (FiO₂). Stating that "the incubator was flooded with 100% oxygen at 4 liters/min" does not give adequate information, as there are sufficient leaks in the incubator to prevent more than ~30% oxygen being achieved. It is better to have an oxygen analyzer next to the baby's face and record the concentration that the baby is breathing. Once ordered, it should be adjusted to maintain O₂ saturation between 90-95%. Care should be taken to avoid saturation > 95% in babies < 1500 g.

It is preferable to warm and humidify gases that are delivered to the infant to minimize cold stress and insensible water loss. To help maintain a stable concentration of oxygen, an anesthesia bag and mask, or oxygen tubing inserted through a Styrofoam cup, acting as a funnel is useful when a hood box is not available.

Clinical observations of the infant's response to oxygen therapy include: colour, respiratory rate, respiratory effort, and state (e.g. hypoxic infants are often restless). These

observations should be recorded hourly until the infant's condition is stabilized, then every 2-4 hours, as required.

SWEET

Glucose is the primary source of energy for the fetus. This glucose is derived entirely from the mother and fluctuates with changes in maternal glucose. At birth there is a sudden cessation of nutrient supply. The newborn must mobilize glucose and fatty acids from stores to meet energy demands. The umbilical venous glucose at birth is about 60-80% of maternal venous glucose. Upon cord clamping, there is a steady decline in glucose levels reaching a nadir by 2-3 hours after birth. This is associated with a hepatic release of glucose of 4-6mg/kg/min. A wide range of problems can disrupt this normal adaptation putting some babies at risk for significant hypoglycemia. Premature and/or growth restricted infants, as well as infants of diabetics, are unable to mount an appropriate or adequate response to the sudden loss of their continuous intravenous glucose supply.

Clinical manifestations of hypoglycemia could include:

- change in level of consciousness e.g. irritability, lethargy or coma
- hypotonia
- tremors, jitteriness
- apnea
- seizures

When measuring glucose concentrations, remember that reagent strips are not reliable at lower blood glucose levels regardless of whether measured by eye or meters. All low 'screening' results require validation in the lab. At least one reliable lab value that is significantly low should be obtained before a definitive diagnosis can be made.

Screening at-risk babies and aiming for a glucose of at least 2.5mmol/l is a reasonable goal. In 'at risk' babies, values below this level should trigger feeds and close monitoring. Persistent values below this level despite feeds should be treated with intravenous glucose therapy. In symptomatic infants and sick infants, blood glucose should be maintained above this level and likely in the 3-5mmol/l range.

Babies with respiratory distress should not be fed orally, as this greatly increases the work of breathing and often leads to further respiratory deterioration. An intravenous infusion of D10W at 3ml/kg/hr is usually sufficient to maintain a normal glucose level. The glucose should be rechecked ½-1 hour post initiation of infusion. Dextrose concentrations of 25-50% must not be used, as they are caustic to the veins. Boluses of glucose should be avoided as they further fuel the pancreas, increasing insulin production and lead to rebound hypoglycemia.

CHARTING

Documentation of the status of the baby and your interventions is vital. In stressful situations it is easy to forget all the things that should be documented. If a narrative note is used, pertinent information can get buried in the note. Narrative notes are also time consuming and tend to keep staff away from the bedside. In the Southwest region of Ontario, the nurse managers devised an 'Ill Newborn Chart Form' that can be used. This form is a flow chart that prompts staff to review pertinent data, is easy to fill-in, and is clear and concise. It may be used as is, or as a template for an individualized form. When transporting a baby remember to copy this form, as well as the Ontario Antenatal Records, Summary of Birth forms, and Neonatal Resuscitation Records to accompany the infant.

FINALLY

We must not forget the family during this stressful time. They will undoubtedly be anxious and need lots of information and support. Opportunities for them to touch and handle their baby need to be considered; pictures are a must and can be vitally important for the mother when she will be separated from her baby. The family will also need information about the hospital that the baby is going to; how to get there, phone numbers, receiving physician's name, etc.

There is now a one-day course from the United States called the STABLE Program, available in the region to help staff become

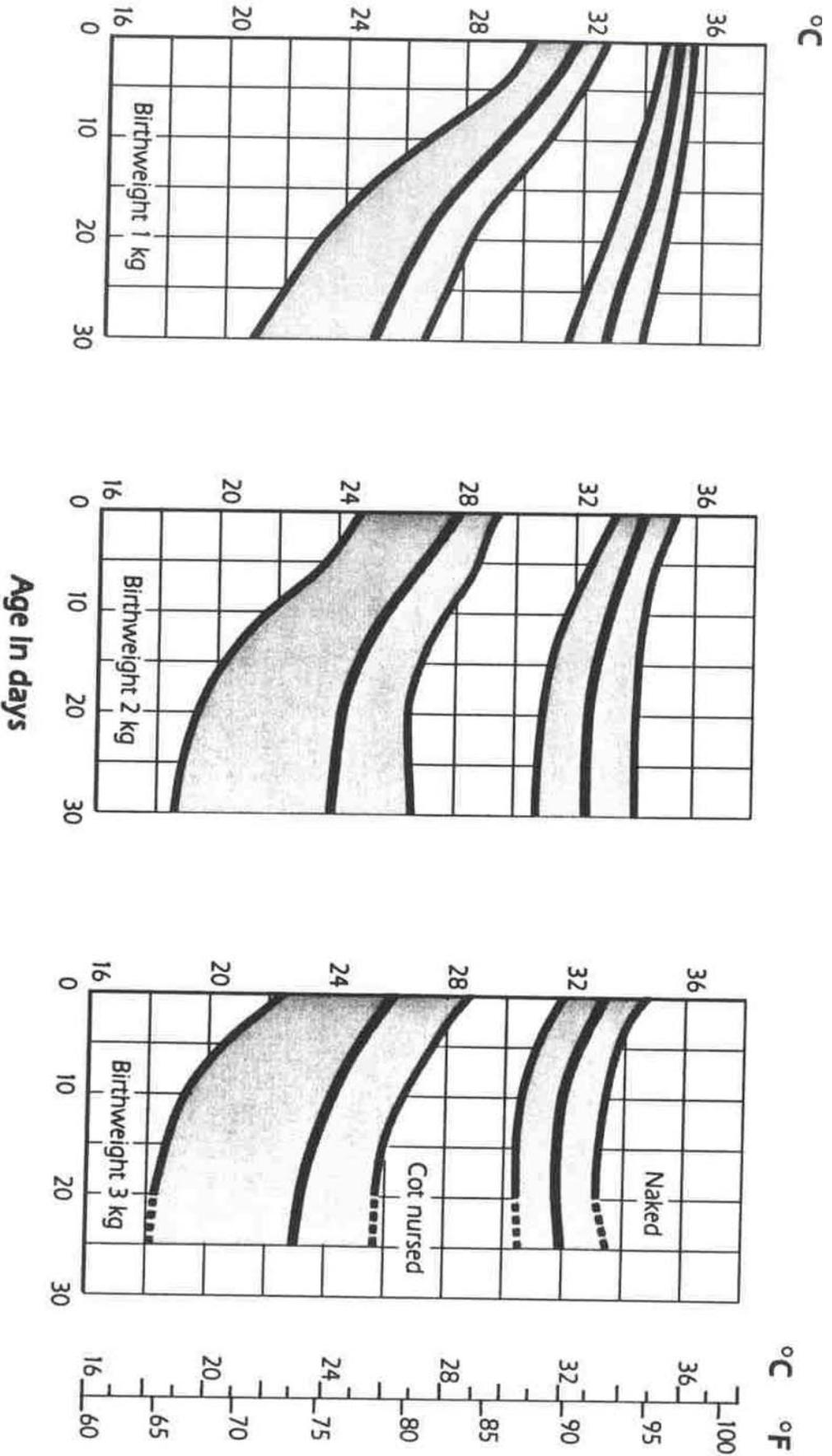
more comfortable with caring for the ill newborn. A one-day Canadian program is being developed, ACoRN (Advanced Care of the Resuscitated Newborn), which will be launched in June of 2003. Watch for it. Meanwhile aim to keep your baby Warm, Pink and Sweet.

YOU ASKED US:

ACoRN (Acute Care of the Resuscitated Newborn), the Canadian neonatal stabilization education program, will be launched at the Canadian Pediatric Society annual meeting in Calgary on June 17, 2003. Watch for workshops to be announced in the coming year.



(Fig. 1)



Post-Discharge Nutritional Considerations in the Preterm Infant

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Human milk is the optimal food for infants regardless of gestation at birth. Smaller, less mature infants (BW \leq 1500g, \leq 30wks) require fortification of human milk with protein, minerals and vitamins during hospitalization to provide adequate amounts of nutrients to support rapid growth. At the same time the infant is developing proficiency in nursing at the breast, the need for nutrient supplementation is likely declining, provided the infant has received a reasonable course of supplementation during their hospital stay. It is unclear whether breastmilk fortifiers continue to provide benefit in supporting growth beyond hospital discharge. However, if breastmilk supply is not adequate, supplementation with preterm infant formula or enriched preterm follow-up formula (soon to be released in Canada) is often recommended at discharge. Issues of adequate breastmilk supply and the infant's breastfeeding ability require individual assessment and management for discharge in order to support breastfeeding success.

For example, if the infant is unable to transfer adequate breastmilk volumes at discharge to support an average weight gain of at least 20g/day and milk supply is adequate, the addition of small amounts of nutrient enriched breastmilk by bottle may be recommended. Support of milk volumes would continue by recommending ongoing pumping of the breasts after feedings. Nipple shield use would continue in order to optimize milk transfer at the breast. Supplemental bottle feedings, pumping and nipple shield use would be weaned as soon as appropriate, based on adequacy of weight gain and breastfeeding progress.

If human milk is not available, formula is prescribed at discharge based on individual needs. Very low birth weight infants (BW \leq 1500g) are recommended to continue to receive preterm formula to \geq 2kg due to requirements for rapid growth. Extremely low birth infants (BW \leq 1000g) who have chronic lung disease, and who may have required prolonged parenteral feeding due to critical illness, may continue on preterm formula beyond this time to 3-3.5kg to support enhanced nutrient delivery, based on nutritional risk (Table 1). As preterm formulas are not available routinely at discharge, they are currently only used on a selective basis. Fortunately, an enriched preterm follow-up formula will soon be available for use in Canada (Neosure, Ross Products Division, Abbott Laboratories Ltd.).

Enhanced nutrient formulas for preterm infants are available elsewhere. They have been shown to enhance post-discharge preterm growth and prevent depletion by providing protein, energy, minerals and vitamins in amounts greater than standard term formulas but in amounts less than preterm formulas. The delivery of excess nutrients (e.g. Vitamin A and D), provided when larger volumes (>500ml) of preterm formula is consumed, is therefore avoided.



Table 1: Infants at Highest Risk for Nutritional Problems After Discharge From NICU
VLBW (≤ 1500 g) Infants
ELBW (≤ 1000 g) Infants
Small for Gestational Age Infants
Breast Fed Infants
Infants on Special Formulas
Prolonged TPN Course (> 4 wks) in hospital
TPN at Discharge
Poverty or Low Socioeconomic Status
Infants with Gastrostomies or Tracheostomies
Infants who require tube feedings at discharge
Infants who are not gaining at least 20g/day at discharge
Infants with any of the Following Diagnoses:
Chronic Lung Disease
Congenital GI Tract Anomalies
Congenital Heart Defects
Inborn Errors of Metabolism
Malabsorption/Short Bowel Syndrome
Osteopenia of Prematurity
Severe Neurological Impairment

The volume of formula consumed should support a minimum weight gain of 20g/day. The term infant experiences the most rapid rate of weight gain of 30 to 35 g/day during the 32 to 36 week gestation period in utero. The preterm infant shows a similar pattern later, between 38 and 48 weeks post conceptual age. This catch-up growth seems to depend on nutrient intake and the absence of ongoing medical problems. Average daily nutrient intakes therefore often exceed that of the term infants, with average reported intakes ranging between 135-165 calories/kg/day, often exceeding 200 calories/kg/day in a significant number of infants. The rate of weight gain beyond this initial period has been shown to mimic that of the term infant, often with little or no catch-up growth up to 8 years of life. Typically, comparison of growth during the first 3 years is based on post conceptual age / term corrected age rather than actual age.

Infants who cannot tolerate large breastmilk or formula volumes due to impaired pulmonary, cardiac, gastrointestinal or neurological function will require feedings of enhanced caloric and nutrient density and/or in some cases supplemental tube feedings. Feeding concerns at discharge occurring more

in the preterm infant can also be related to state/physiological instability, reduced endurance and poor coordination of suck/swallow/breathing. All of these factors may limit the ability to consume adequate milk volumes. Standard concentrated liquid or powdered infant formulas may be prepared at higher caloric densities or added to expressed breastmilk to increase densities up to 27 to 30 calories per ounce in order to meet requirements.

Vitamin requirements for preterm infants are similar to term infants for those reaching 2 kg. For infants discharged on preterm formulas, human milk fortifiers or enriched preterm follow-up formulas, added vitamins are generally not needed. If infants are discharged on standard term formulas, 0.5 to 1.0 ml daily of Poly-vi-sol or Tri-vi-sol is recommended until greater than 750ml of formula is consumed. The breastmilk fed preterm infant requires 0.5-1.0 ml of D-vi-sol, Tri-vi-sol or Poly-vi-sol to support 200-400 IU/day of additional Vitamin D until other dietary sources are added.

Iron is needed for the preterm infant within the first month of life in a recommended dose of 3-4mg/kg/day elemental iron if birth weight was ≤ 1000 g, and 2-3mg/kg/day in infants born at > 1000 g, according to needs for more rapid growth, and due to the absence of any appreciable iron storage occurring prior to 32 weeks gestation in utero. This is supplied as Ferrous Sulfate (Fer-in-sol, 1.5 mg elemental iron/0.1ml) in the breastmilk fed preterm infant up to a maximum reasonable dose of 15mg (1.0ml) daily. Standard infant formulas and nutrient enriched follow-up formulas generally provide 12mg/L elemental iron or approximately 2 mg/kg/day if average volumes of 170ml/kg/day are consumed. Therefore, additional supplemental iron may be prescribed in the ELBW infant at discharge, or for the VLBW infant, based on adequacy of iron delivery and iron storage up to the time of discharge.

The calcium and phosphorous content of breastmilk and term formulas, as well as the zinc content of term formulas, may be inadequate to support normal accretion rates during the rapid catch-up growth phase from 38 to 48 weeks post conceptual age. Continued use of preterm formulas, human milk fortifiers, enriched preterm follow-up

formulas or individual mineral supplements may be a consideration during this phase, especially if osteopenia of prematurity has been identified.

The timing of introduction of solid foods and milks other than breastmilk or infant formula for the preterm infant is the same as that for the term baby of the same post conceptual age. For example, solid foods are recommended at 4 to 6 months post term corrected age. Whole cow's milk should not replace breastmilk or iron fortified infant formula until one year beyond term corrected age to ensure adequate intakes of iron, vitamin B6, vitamin C and essential fatty acids.

Nutritional follow-up may be an integral part of early post discharge follow-up, especially in those infants considered to be at highest nutritional risk (Table 1). Early follow-up by a Registered Dietitian at 2 to 4 weeks post-discharge may be planned in these infants via Developmental Follow-up Programs to monitor growth, feeding progress and specific nutritional interventions at discharge. Subsequent developmental follow-up visits are usually based on age coinciding with developmental milestones at 4, 8, 12, 18, 24 and 36 months term corrected age. Infants at nutritional risk have been shown to benefit from ongoing nutritional assessment and intervention by a Registered Dietitian during the first year of life, through achievement of enhanced catch-up growth in weight, length and head circumference.



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FOR YOUR INFORMATION:

Regional Perinatal Services Project **Progress to Date**

With the recognition that access to perinatal services in Southwestern Ontario is being challenged, primarily due to the increasing shortage of medical, nursing and allied health human resources, the Regional Perinatal Services Project has been established to address the issue.

Purpose: To ensure access to appropriate perinatal services throughout Southwestern Ontario.

Goal: To identify viable and practical strategies to ensure on-going access to appropriate perinatal care throughout the region, using a collaborative partnership approach.

To date, Phase 1, 2, 3 and 4 of the project have already been completed. Letters were sent to all hospitals, CCACs and Public Health Units in the region advising them of the proposed initiative. Additionally, presentations were made at Regional Perinatal Nurse Manager meetings. Personal interviews involving each of the 26 centres currently providing perinatal and related services in Southwestern Ontario have now been completed. These reports have been sent back to the participating hospitals and have now all been validated.

It is planned there will also be information/opinion gathering from patients and families together with a collection of the relevant demographic and trend information.

Phase 5: – Analysis of Findings is to be completed January 2003. At this time, four geographic-based stakeholder Task Groups (Grey-Bruce, Huron-Perth, Thames Valley, and Essex, Kent, Lambton) will be brought together to review statistical data and interview findings. Each group will be asked to develop strategies to address immediate issues, discuss sustainability issues, cost implications, recommendations, and next steps.

Phase 6 involves consultations with stakeholders outside of the Task Group participants. These consultations will take place to get feedback on draft recommendations and directions will be developed. It is hoped that this will be completed by February 2003.

Phase 7 is the approval/presentation process whereby an implementation plan based on consultations is to be undertaken. This will include resource needs and an impact analysis. A presentation of the report and recommendations will be made to management, medical staff, and hospital boards for review and endorsement. This should be finalized by April 2003.

For further information regarding the Perinatal Services Project, please contact either Mike Barrett at Michael.barrett@moh.gov.on.ca or Nancy Dodman at nancy.dodman@sjhc.london.on.ca.

UPCOMING EVENTS:

Mark Your Calendar!

17th Annual Regional Perinatal Outreach Conference

Wednesday, September 17, 2003
Location: Lamplighter Inn, London
Topics: To be Announced
Contact: Perinatal Outreach Office
(519) 646-6100, ext. 65859

Clinton:

Thursdays: Mar 27 – May 15, 2003
(excluding Apr 10)

Contact:

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Leamington:

Mondays: Apr 28 – June 16, 2003
(excluding Mon. May 19, 2003)

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London:

Mondays: Apr 28 – Jun 16, 2003
St. Joseph's Health Care, London
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