Get to the Sweet Spot in Neonatal Hypoglycemia Brain Injury Cases
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GET TO THE SWEET SPOT IN NEONATAL HYPOGLYCEMIA BRAIN INJURY CASES

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GET TO THE SWEET SPOT IN NEONATAL HYPOGLYCEMIA BRAIN INJURY CASES

I. INTRODUCTION

A. Immediate Postnatal Drop in Blood Glucose Is Physiologic

B. Target Glucose Screen ≥ 45mg/dL Prior to Feeds

C. Overall Incidence of Neonatal Hypoglycemia One to Five Per 1,000 Live Births

D. Neonatal Hypoglycemia Is Not a Discrete Medical Condition

E. Exact Parameters of Normal Blood Glucose in Neonate Remain Controversial

F. No Recognized Duration of Hypoglycemia Predicts Permanent Neurological Injury

G. Prolonged or Recurrent Low Glucose Levels May Lead to Long Term Neurodevelopment Sequelae

1. White matter damage to occipital and parietal lobes of brain.

2. Chronic seizures.

3. Epilepsy diagnosis.

4. Mental retardation.

5. Blindness.

6. Hearing loss or complete deafness.

7. Impaired cognitive and motor functions.


9. Cerebral palsy.
10. Cerebral infarcts.
11. Irreversible coma.

H. Fast, Relatively Easy Treatment Has Limited Side Effects

II. PATHOPHYSIOLOGY OF NEONATAL HYPOGLYCEMIA

A. Glucose Is Major Substrate for Fetal Metabolism

B. Neonatal Hypoglycemia Result of
   1. Inadequate hepatic glucose production that cannot meet peripheral demand or
   2. Excessive insulin production.

C. Failure to Increase Glucose Concentrations After Four Hours Is Considered Pathologic

D. During Episode, Brain Increases Blood Flow to Improve Glucose Delivery

E. A Hypoglycemic Event Can Predispose the Neonatal Brain to Hemorrhagic and Hypoxic Injury

F. When Glucose Consumption Exceeds Delivery, Brain Uses Alternate Energy Sources for Cerebral Metabolism and Perfusion
   1. Ketone bodies.
   2. Lactic acid.

G. Production of Energy from Alternate Energy Sources Involves Brain Structural Components That Play a Role in Brain Injury
H. Prolonged Hypoglycemia Not Compensated by Alternate Fuels Induces Biochemical Changes at Cell Level

1. May damage neuronal and glial brain cells.

I. A Neonatal Hypoglycemic Brain May Be More Vulnerable to Ischemia

III. CAUSES OF NEONATAL HYPOGLYCEMIA AND POPULATIONS AT RISK

A. Maternal Fetal Conditions Leading to Transient Hypoglycemia

1. Perinatal stress.
2. Sepsis.
3. Asphyxia and hypoxic ischemic encephalopathy (HIE).
4. Hypothermia.
5. Polycythemia.
6. Shock.
7. Maternal gestational or insulin-dependent diabetes.
8. Maternal drugs or beta-sympathetic agents.
   a. Terbutaline.
   b. Propanolol.

B. Decreased Glycogen Stores

1. Intrauterine growth restriction (IUGR).
2. Small for gestational age.
3. Prematurity.
4. Late pre-term (34-36 weeks).
5. Postmaturity (post 40 weeks gestation).
C. Recurrent or Persistent Hypoglycemia (Exhibit A)

1. Hormone excess hyperinsulinemia.
   a. Beckwith-Wiedman syndrome.
   b. Islet cell adenoma.
   c. Adenomatosis.
   d. Beta cell hypoplasia.

2. Hormone deficiencies.
   a. Growth hormone.
   b. ACTH unresponsiveness.
   c. Thyroid.
   d. Epinephrine.
   e. Glucagon.
   f. Cortisol.
   g. Hypoplastic pituitary.
   h. Congenital nerve hypoplasia.
   i. Hypothalmic hormone.
   j. Midline central nervous system malformations.

3. Hereditary defects in amino acid metabolism.
   a. Maple syrup urine disease.
   b. Propionic acidemia.
   c. Methylmalonic acidemia.
   d. Tyrosinosis.
   e. E-hydroxy-3-methylglutaryl-coalyse deficiency.

   a. Glycogen storage disorder.
   b. Fructose intolerance.
   c. Galactosemia.
   d. Glycogen synthase deficiency.
   e. Fructose-1, 6-diphosphatase deficiency.

5. Hereditary defects in fatty metabolism.
   a. Medium and long chain deficiency.

IV. MANAGEMENT OF NEONATAL HYPOGLYCEMIA GUIDELINES (EXHIBIT B)

A. Widely Used Plasma Glucose <40-45 mg/dL
B. Identify Infants at Risk
   1. Perinatal history.
   2. Physical examination.
   3. Body measurements (weight, length, head circumference).
   4. Gestational age assessment
      a. AGA (appropriate for gestational age).
      b. SGA (small for gestational age).
      c. LGA (large for gestational age).
      d. IUGR.

C. Symptomatic v. Asymptomatic
   1. Tremors.
   2. Jitteriness.
   3. Cyanosis.
   4. Seizures.
   5. Apnea.
   6. Tachypnea.
   7. Pallor.
   8. Weak or high pitched cry.
   9. Poor tone.
   10. Poor, uncoordinated feeding.
   11. Refusal to feed orally.
   12. No suck reflex.
   13. Hypothermia.
   14. Exaggerated moro (startle) reflex.
   15. Eye rolling.

D. Prevent Hypoglycemia with Early Feedings
E. Assess Glucose with Blood Glucose Screening
   1. Within 30 minutes of admission.
   2. Prior to first three or four feedings.
   3. At two, four, six, 12 and 24 hours.
   4. Every 24 hours if infant NPO.
   5. After changes to feeding, IV regime or bolus dextrose.
   6. Follow facility’s algorithm or protocol.
   7. Follow physician orders if different from protocol.

F. IV Glucose 4 to 6 mg/kg/minute of D10W Following Birth

G. IV Glucose Bolus of 2 ml/kg of D10W Standard IV Correction May Be Repeated

H. Increase Continuous Glucose Infusion Rate to 6 to 8 mg/kg/minute

I. Persistent Hypoglycemia Be Suspicious of Hyperinsulinemia
   1. Increasing or high glucose infusion rates.
   2. Delivery of concentrated glucose in excess of D12.5%.
   3. Placement of central venous access for safety.
      a. Minimize interruptions in infusion for infant dependent on glucose.
      b. High risk of peripheral IV infiltration.
      c. Dextrose >12.5% requires central venous access for safe infusion.

J. Endocrine Consult and Lab Work
   1. Hormonal therapies.
      a. Glucagon.
      b. Diazoxide.
      c. Somatostatin.
      d. Glucagon if appropriate and IV access failed.
      e. Corticosteroids.
      f. Human growth hormone.
K. Imaging and Diagnostics

1. Ultrasound abdomen or gallbladder.

2. CT/MRI.
   a. Brain.
   b. Pancreas.
   c. Pituitary gland.

3. F-DOPA PET scans.

L. Diet Regulated and Metabolic Defects

1. Fructose free.

2. Galactose free.

M. Surgical Pancreatectomy

V. COMMON PLAINTIFF ALLEGATIONS FOR NEONATAL HYPOGLYCEMIA CASES

A. Failure to Properly Monitor Maternal Glucose Levels During Pregnancy

B. Failure to Fully and Properly Educate the Mother on the Potential Risks Diabetes Has on Her Pregnancy and the Fetus

C. Failure to Properly Monitor the Dosages of any Beta-Sympathetic Drugs Administered to the Mother During the Pregnancy

D. Failure to Properly Educate the Mother on the Hypoglycemia Risks to the Infant After Birth as a Result of Being on Beta-Sympathetic Drugs During Pregnancy

E. Failure to Follow Hypoglycemia Algorithm or Protocol Resulting in Ineffective Glucose Screening and Hypoglycemia Not Treated in Timely Fashion
F. Failure to Perform Complete Physical Assessment of High-Risk Neonate Resulting in Ineffective Glucose Screening and Hypoglycemia Not Recognized or Treated in Timely Manner

G. Failure to Monitor Bedside Glucoses as Ordered Resulting in Ineffective Glucose Screening and Hypoglycemia Not Recognized or Treated in Timely Manner

H. Failure to Reassess Glucose Levels Within Appropriate Time Frame (30 minutes) Following Dextrose Intervention

I. Failure to Send Serum Glucose to Central Laboratory to Confirm Hypoglycemia After Performing Bedside Glucose

J. Failure to Treat Hypoglycemia in Timely Manner Resulting in Prolonged Hypoglycemic Event

K. Failure to Execute Glucose Treatment as Ordered in Timely Manner Resulting in Delay and Prolonged Hypoglycemia

L. Failure to Communicate Glucose Results in Timely Manner Resulting in Delay and Prolonged Hypoglycemia

M. Failure to Establish Central Venous Access for Maximum Dextrose Infusion on High-Risk Hypoglycemic Infant Resulting in Repetitive Hypoglycemic Events and Neurologic Damages

N. Failure to Establish Central Venous Access for Stability and Uninterrupted Dextrose Infusion on High-Risk Hypoglycemic Infant Resulting in Multiple Peripheral IV Attempts and Interruptions in Dextrose Therapy Leading to Recurrent Hypoglycemic Events

O. Failure to Manage Neonatal Hypoglycemia Appropriately by Infusing Dextrose Concentrations Higher Than D12.5% Through Peripheral IV Lines Resulting in IV Infiltrates and Need for Multiple Peripheral IV Attempts with Interruptions in Dextrose Therapy Causing Recurrent Hypoglycemia

P. Failure to Advocate for Central Venous Access Placement with Need for Repeated Peripheral IV Placement and Infusion of Dextrose Concentrations Greater than D12.5% Ordered Peripherally
Q. Failure to Order Continuous Intravenous Dextrose Infusion for High-Risk Neonate Resulting in Recurrent Hypoglycemia

R. Failure to Notify Physician or Practitioner of High-Risk Neonate’s Poor Oral Intake and Feeding Tolerance Resulting in Hypoglycemia

S. Failure to Use the Appropriate Glucose Concentration and/or Infusion Rate Resulting in Ineffective Hypoglycemia Treatment

T. Failure to Provide Effective Lactation Support and Education to Mother of High-Risk Infant Who Was Feeding Poorly with Excessive Weight Loss Resulting in Severe Hypoglycemia Episode, Seizures and Permanent Neurologic Damage

U. Failure to Obtain Neonatology and Endocrinology Consults to Assist in Management of Persistent Hypoglycemia Leading to Recurrent Hypoglycemia and Delayed Diagnosis and Treatment of Endocrine Disorders

V. Failure to Transfer Infant to a Higher Level of Care in Timely Manner to Assist in Management of Persistent Hypoglycemia Leading to Recurrent Hypoglycemia and Delayed Diagnosis and Treatment

VI. COMMON DEFENSES FOR NEONATAL HYPOGLYCEMIA CASES

A. Mother Was Noncompliant with Glucose Monitoring, Diet, Medication Regime

B. Universal Screening Not Required Nor Recommended in Asymptomatic Term Infant

C. Inaccurate Interpretation of Bedside Testing Reagent Strips

D. Infant Was Asymptomatic

E. Hypoglycemia Signs Were Subtle

F. Laboratory Error
G. Hypoglycemia Algorithm and Protocol Were Followed

H. Glucose Concentration of D15 Acceptable Peripherally for 24 hours

I. LATCH Scores for Breastfeeding Were Acceptable

J. Lactation Consultant Performed Visit

K. Brain Damage Due to Unnamed, Nonspecific, Undiagnosed Metabolic Abnormality

L. Brain Damage and Seizures Were Result of Birth Injury and Not Hypoglycemia

M. No Factual Support or Reasonable Basis for Hypoglycemia Causing Brain Injury

N. Bedside Glucose Reagent Strips Expired Leading to Inaccurate Results

O. Blood Glucose Reading “Borderline” Normal

VII. THE ROLE OF THE CERTIFIED LEGAL NURSE CONSULTANtCM IN NEONATAL HYPOGLYCEMIA CASES

A. Act as Your Attorney-Client’s Personal Clinical Educator on Neonatal Hypoglycemia
   1. Brief overview of pathophysiology of brain and fetal glucose metabolism.
   2. Educate on at-risk populations and neonatal risk factors.
   3. Types of dextrose infusions and intravenous access requirements.
   4. Levels of care.
   5. Point of care testing v. central laboratory specimens.
B. Assemble Detailed Glucose Nursing and Physician Chronology (Exhibit C)

1. All glucose levels.
2. All glucose interventions.
4. Physician orders related to glucose.
5. Pertinent labs performed.

C. Interview Mother and Family Members

1. Prenatal history for current pregnancy.
   a. Diabetes screening, management, monitoring.
   b. Medications taken during pregnancy.
   c. Risk factors.
   d. Previous pregnancies, siblings or family history with diabetes or hypoglycemia issues.

2. Timing of interviews.
   a. Feedings, bottle or breast.
   b. Shift assessments.
   c. Infant’s level of consciousness.
   d. Lactation consultant visits.
   e. Lab testing.
   f. IV access insertion or discontinuation.

D. Analyze Relevant Medical Records

1. Maternal records
   a. Prenatal.
   b. Obstetrician.
   c. Labor and delivery.
   d. Endocrinology.
   e. Internal medicine.
   f. Family practice.
   g. Dietician consults.
   h. Lactation consults.

2. Infant records
   a. APGARS.
   b. Gestational age assessment.
   c. Admission assessment.
   d. Initial glucose screening results and timing.
e. Standing newborn admission orders (pre-printed).
f. NICU physician orders.
g. Hypoglycemia algorithm.
h. Hypoglycemia protocol.
i. Bedside glucose testing results.
j. I/O records.
k. LATCH scores.

3. Physician records.
a. Orders if different from standing algorithm.
b. Daily progress notes and examinations.
c. Physician consults.
d. Narrative note entries and plan of care.

4. Nursing records.
a. Head-to-toe physical assessments of infant-nursing flow sheets.
b. Orders acknowledged and chart audits performed.
c. Timing of screening, glucose interventions and reporting of critical values.
d. Education on breastfeeding, s/s hypoglycemia for at-risk infants, bottle feeding.
e. Narrative entries.
f. Vital signs and changes.
g. Parenteral IV (PIV) records of types of sites infusing, saline locked, discontinued, restarts, infiltrated.
h. MARs for dextrose fluids infusing, changed, rates, routes.
i. Policies and procedures on weight loss, gavage feeds, PIV and CVAC.
j. Hypoglycemia plan of care.

5. Additional records.
a. Maternity service plan.
c. Clinical competency.

6. Laboratory data
a. Point of care testing of bedside glucose results.
b. Serum blood glucose.
c. Basic metabolic panels.
d. CBC with differential.
e. Blood cultures.
f. Newborn state metabolic screen.
g. Insulin.
h. Immunoglobulin G (I/G) ratio.
i. Growth hormone.
j. Cortisol.
k. Free fatty acids.
l. Thyroid studies TSH, T3, T4.
m. Glucagon.
n. Lactate.
o. Alanine.
q. Amino acids serum and urine.
r. Somatomedins.
s. Hemoglobin A1C.
t. Remainder of sepsis work-up if applicable.

7. Diagnostics.

a. Receptor gene ABCC8 variant.

E. Assist with Discovery
1. Recommend requesting pertinent hypoglycemia, feeding and intravenous access algorithm, protocols and procedures.
2. Draft interrogatories and requests for production.

F. Assist with Deposition
1. Prepare customized deposition questions for all disciplines.
   a. Nursing.
   b. Physicians.
   c. Laboratory technicians.
   d. Patient care technicians.
   e. Phlebotomists.
   f. Family members and friends.
2. Analyze deposition transcripts.
   a. Create narrative summaries of individual testimony.
   b. Correlate testimony on record with events documented in clinical record.

G. Identify Standards of Care for Neonatal Hypoglycemia, Screening and Management

H. Recommend and Locate Expert Witnesses
1. Neonatologist.
2. Obstetrician.
3. Pediatrician.
4. Emergency department (ED) physician.
5. Family practice physician.
6. Pediatric endocrinologist.
7. Pediatric neurologist.
8. Pediatric neuroradiologist.
10. NICU nurse.
11. Nursery nurse.
12. Pediatric nurse.
13. ED nurse.
14. Nurse practitioner
   a. Neonatal.
   b. Pediatric.
   c. Family.
15. Nursing management.
17. Physical therapists.
18. Occupational therapists.
19. Speech therapists.
20. Life care planner.

I. **Perform and Organize Literature Review on Neonatal Hypoglycemia**

J. **Assemble Exhibits and Perform Demonstrations at Trial**
   1. Poster size algorithms, protocols, order sets.
   2. Demonstrate bedside heel stick glucose procedure on infant mannequin.
K. How to Gain Attorney-Clients
1. Market to birth injury attorneys.
3. Perform internet searches for attorneys specializing in neonatal litigation.
4. Write an article on neonatal hypoglycemia brain injury for your CLNC® business newsletter or website.
5. Work with CLNC® subcontractors.
6. Ask existing attorney-clients for referrals.
7. Speak at legal conferences on neonatal hypoglycemia.
8. Speak at neonatology and pediatric conferences on neonatal hypoglycemia.
9. Consult on adult hypoglycemia cases.

VIII. INTERROGATORIES AND REQUESTS FOR PRODUCTION

A. Interrogatories Directed to the Defense

1. Please state the name, last known business address and last known home address of any and all (Facility) __________ personnel who rendered care to (Minor plaintiff) __________ from (Date) __________ to (Date) __________ and including the delivery of (Minor plaintiff) __________ on (Date) __________.

2. Please identify any and all individuals who monitored (Minor Plaintiff) __________’s glucose levels at (Facility) __________ from (Date) __________ to (Date) __________.

3. Please identify the name of each individual who attempted to and/or inserted a peripheral IV or central venous catheter into (Minor plaintiff) __________ and the date(s) of any such attempts and/or insertion.

4. Please explain how the results of bedside glucose testing and serum glucose levels were communicated to the healthcare providers at (Facility) __________ from (Date) __________ to (Date) __________.
5. Please explain the process for screening and treating neonatal hypoglycemia at (Facility) __________ from (Date) __________ to (Date) __________.

6. Please explain how the healthcare staff at (Facility) __________ from (Date) __________ to (Date) __________ was educated about neonatal hypoglycemia, risk factors and treatment of hypoglycemia.

7. Please explain how parents were educated and informed of neonatal hypoglycemia and risk factors at (Facility) ______ from (Date) __________ to (Date) __________.

8. Please explain the process for obtaining a lactation consultant visit for a mother at (Facility) __________ from (Date) __________ to (Date) __________.

B. Interrogatories Directed to the Plaintiff

1. Please provide the name, address and title of the person answering on behalf of (Minor plaintiff) __________.

2. Please provide the name, address and title of all healthcare providers and specialists (Minor plaintiff) __________ has seen for any reason from (Date) __________ to (Date) __________.

3. For each of the healthcare provider listed above, please provide a brief description of the reason(s), including signs, symptoms and complaints, for which (Minor plaintiff) __________ saw each provider, the nature and extent of any treatment received and the diagnosis and prognosis.

4. Please list the names and ages of any siblings of (Minor plaintiff) __________, and any health conditions they have been treated for from birth to present.

5. Please provide the names, ages and addresses of any family members with diabetes, genetic disorders, metabolic disorders or endocrine disorders and a brief description of their disorder.

6. Please provide a list of any and all medications including supplements that (Minor plaintiff) __________ has taken or is currently taking from (Date) __________ to (Date) __________.

7. Please have mother of (Minor plaintiff) ______ list an example of her daily diet consumed while pregnant with (Minor plaintiff) ______ from (Date) ______ to (Date) ______.
8. Please have mother of (Minor plaintiff) __________ describe her daily gestational diabetes or insulin dependent diabetes monitoring, treatment and medication regime.

C. Requests for Production Directed to the Defense

1. Please provide any and all medical records including maternal, inpatient and outpatient records, charts, nursing notes, physician orders, emergency department records, medication records, laboratory results, diagnostic test results, discharge summaries, X rays, CT and MRI reports, pathology reports and any and all records regardless of the date relating to the care of (Minor plaintiff) __________.

2. Please provide any written policies and procedures in effect at (Facility) __________ from (Date) __________ to (Date) __________ pertaining to the screening and monitoring of neonatal blood sugars for hypoglycemia.

3. Please provide any written policies and procedures in effect at (Facility) __________ from (Date) __________ to (Date) __________ pertaining to the management and treatment of neonatal hypoglycemia.

4. Please provide any written policies and procedures in effect at (Facility) __________ from (Date) __________ to (Date) __________ containing a definition of neonatal hypoglycemia.

5. Please provide copies of all standing orders or order sets for newborn nursery, pediatrics and NICU related to glucose screening in neonates at (Facility) __________ from (Date) __________ to (Date) __________.

6. Please provide any and all medical records and reports reflecting (Minor plaintiff) __________’s glucose levels at (Facility) __________ from (Date) __________ to (Date) __________.

7. Please provide a copy of a formulary with drugs used on neonates at (Facility) __________ from (Date) __________ to (Date) __________.

8. Please provide a copy of any written policy relating to administration and/or monitoring of dextrose infusion on infants at (Facility) __________ from (Date) __________ to (Date) __________.
9. Please provide a copy of the following nursing protocols for (Facility) __________ in effect from (Date) __________ to (Date) __________.
   a. Peripheral IV management.
   b. Post delivery management.
   c. Transfer to NICU.
   d. Care of patient with central venous access catheter.
   e. Care of UAC and UVC umbilical lines.
   f. Hypoglycemia algorithm.

10. Please provide a copy of all neonatal and pediatric care competency records related to bedside glucose screening for all personnel involved in the care of (Minor plaintiff) __________ from (Date) __________ to (Date) __________.

11. Please provide copies of educational materials used for parent education on neonatal hypoglycemia at (Facility) __________ in effect from (Date) __________ to (Date) __________.

D. Requests for Production Directed to the Plaintiff

1. Please provide copies of any photos, video recordings, radiological images and any other tangible items related to the care of (Minor plaintiff) __________ from (Date) __________ to (Date) __________.

2. Please provide any documentation specific to the care of (Minor plaintiff) __________ written by any family member or witness from (Date) __________ to (Date) __________.

3. Please provide a copy of all medical and other related expenses incurred by (Minor plaintiff) __________, including medications, supplements and medical equipment from (Date) __________ to (Date) __________ related to hypoglycemia brain injury diagnosis.

4. Please provide a copy of any and all educational or written teaching materials provided to a family member by (Facility) __________ pertaining to neonatal hypoglycemia, risk factors, signs and symptoms and treatment from (Date) __________ to (Date) __________.

5. Please provide a list of all school records of (Minor plaintiff) __________ including addresses and dates attended.

6. Please provide a list of all current medications including over the counter and supplements as well as their uses for (Minor plaintiff) __________.
7. Please provide any copies of educational materials that mother of (Minor plaintiff) __________ received related to gestational diabetes, nutrition, instructions for monitoring maternal blood sugars, risks to the unborn fetus from uncontrolled diabetes during pregnancy, insulin use and oral anti-diabetic use from (Date) __________ to (Date) __________.

8. Please provide any copies of maternal blood sugar monitoring, tracking and reporting during pregnancy of (Minor plaintiff) __________ from (Date) __________ to (Date) __________.

9. Please provide documentation of any and all medications including over the counter and supplements that mother of (Minor plaintiff) __________ took during pregnancy with (Minor plaintiff) __________ from (Date) __________ to (Date) __________.

IX. RECOMMENDED QUALIFICATIONS FOR CLNC® SUBCONTRACTORS FOR NEONATAL HYPOGLYCEMIA CASES

A. Active in Desired Clinical Area

B. Minimum of Five Years Nursing Experience in Clinical Area

C. Authored Policy and Procedure or Member of Policy and Procedure Committee

D. Experience with Previous Neonatal Hypoglycemia Litigation

E. Strong Communication Skills

F. Ask Other CLNC® Consultants for Referrals

G. Assess Experience
   1. Maternal management and prenatal issues.
   2. Obstetric involvement.
   3. Inpatient or outpatient clinical setting.
   4. Life care planning.
5. RN v. APN.

6. Education or administrative level.

H. Specialty Certifications and Members of Professional Organizations

X. CASE STUDIES

A. Recurrent or Persistent Hypoglycemia Case Study (Exhibit A)

B. Hypoglycemia Case Study (Exhibit D)

XI. RESOURCES

A. Associations and Organizations

1. The Academy of Breastfeeding Medicine. bfmed.org
3. American Diabetes Association. diabetes.org
4. Association of Women’s Health, Obstetric and Neonatal Nurses. awhonn.org
5. International Lactation Consultant Association. ilca.org
6. The Joint Commission. jointcommission.org
7. La Leche League International. lalecheleague.org
8. National Association of Neonatal Nurses. nann.org
9. National Association of Pediatric Nurse Practitioners. napnap.org
nichd.nih.gov

nih.gov

genes-r-us.uthscsa.edu

pens.org

pedsnurses.org

15. World Health Organization. 
who.int

B. Authoritative Textbooks


C. Journal Articles


D. Websites

1. Better Medicine™ from Healthgrades™. [bettermedicine.com](http://bettermedicine.com)

2. Children’s Hospital of Philadelphia. [chop.edu](http://chop.edu)

3. Early Head Start National Resource Center. [ehsnrc.org](http://ehsnrc.org)

4. eMedicine®/Medscape. [emedicine.medscape.com](http://emedicine.medscape.com)

5. Epilepsy Foundation. [epilepsy.com](http://epilepsy.com)

6. March of Dimes. [marchofdimes.com](http://marchofdimes.com)


9. Neonatology on the web. [neonatology.org](http://neonatology.org)

10. NeoReviews. [Neoreviews.aappublications.org](http://Neoreviews.aappublications.org)

11. Pediatrics in Review. [pedsinreview.aappublications.org](http://pedsinreview.aappublications.org)

12. WebMD®. [webmd.com](http://webmd.com)
Exhibit A
Recurrent or Persistent Hypoglycemia Case Study

A term male infant was born after an uneventful pregnancy to a 28-year-old gravida I woman who had no evidence of hypoglycemia and no maternal illness or chronic diseases. The infant was born via normal spontaneous vaginal delivery, and had APGAR scores of 7 and 9. His growth parameters were in the normal range for weight, height and head circumference making him appropriate for gestational age (AGA). The baby transitioned and was taken to well baby nursery where he was examined, bathed and then taken to the mother for nursing at two hours of age. He did appear slightly jittery at that time and was not very interested in nursing or very alert. A bedside blood sugar was obtained measuring 25 mg/dL. Per the hospital’s hypoglycemia protocol for nursery, the baby was fed 25 ml of 5% dextrose in water. The follow-up blood sugar obtained one hour later was 40 mg/dL, and the baby nursed for about five minutes at each breast with apparent satisfaction. The jitteriness and “lack of interest” were improved.

Normal nursery routine was followed with no comment in the charting by the nursing staff about the infant’s feeding or behavior until the second day of life when he again appeared jittery and fussy. Bedside heel stick glucose at that time was 20 mg/dL. The infant was fed by breast or with bottle routine term infant formula alternating every two hours, with improvement in clinical signs. Bedside glucose screenings were sporadically done over the next 24 hours and were variable, but the overall concentration increased with a predischarge pre-prandial value of 50 mg/dL.

The family failed to return to the hospital clinic the next day, but did see their primary care physician on the fifth day of life at which time the infant acted hungry, was noted to be very active and had gained weight. At two weeks of life, the parents noted the infant to be very fussy, startled, jittery and began experiencing staring spells. They brought him into the local emergency department, where he was noted to have lost weight, appeared somnolent but fussy when aroused and started having seizure activity with jerking of all extremities. A serum glucose level was drawn and was noted to be 10 mg/dL. The infant was treated with intravenous glucose, and the seizure activity resolved. Over the next several weeks, the infant returned to the same emergency department several times with similar episodes.

When finally examined by his primary care pediatrician, the infant had gained weight but appeared “puffy.” A heel stick glucose in the office was 35 mg/dL. The infant at that time was referred to a pediatric endocrinologist, who noted the infant’s weight was approaching the 90th percentile, that there was hepatomegaly on examine and that the infant seemed “apathetic.” After being admitted to the pediatrics unit in the local community hospital, several serum glucose concentrations were measured at less than 40 mg/dL, with plasma insulin levels all greater than 20 mcU.ml.

The baby boy was treated with diazoxide with only limited success over the next three months. His development continued but was delayed. He was treated in the local
emergency department three more times for tonic-clonic seizures, all requiring intravenous glucose to correct the severe hypoglycemia. At five months of age, the infant underwent a subtotal pancreatectomy. While recovering, he had a severe prolonged seizure, and was noted to be in shock, requiring two rounds of resuscitation. E-coli meningitis was diagnosed and treated successfully with antibiotics.

At one year of age, the infant showed little development gain from six months of age. At five years of age, he exhibited extremely poor growth, had diabetes mellitus that necessitated insulin, and required pancreatic enzyme replacement with feedings to treat malabsorptive diarrhea. He was completely deaf and partially blind with marked developmental delay. His parents sought legal counsel claiming the birth hospital failed to manage his hypoglycemia and diagnose a “hyperinsulinemia” condition that lead to delayed diagnosis and treatment, followed by severe neurologic damage.


Exhibit B
Management of Neonatal Hypoglycemia Guidelines

ALGORITHM: MANAGEMENT OF NEONATAL HYPOGLYCEMIA

1. Initiate feeding for all neonates as soon as infant is ready, preferably within 1 hour of birth.
   Feed breast milk/colostrum or infant formula—NOT dextrose-water. Colostrum, if available, is preferred to formula.

2. Assess the neonate for presence of the following risk factors and symptoms.
   
   **Risk factors:**
   - Prematurity (age <37 weeks) or LBW (<2500 g)
   - SGA or LGR (<10th percentile for weight)
   - Intrapartum depression (5 min APgar <7)
   - Infants of a diabetic mother (DM)
   - LGA (>90th percentile for weight)
   - Hypothermia (<36.5°C axillary after stabilization)
   - Polyhydramnios (centil Hct >65)
   - Microcephaly or midline defect
   - Maternal terbutaline, beta-blockers, or oral hypoglycemic agent during L&D

   **Major symptoms:**
   - Shivering, hypotonia
   - Ataxia, irritability, high-pitched cry
   - Seizures
   - Apnea, cyanosis
   - Irregular rapid breathing
   - >1 hour grunting, retractions, RR >60

3. Asymptomatic WITHOUT risk factors
   - Check blood glucose at least 30 minutes after conclusion of feeding, but no later than 4 hours of age. If baby wasn’t interested in feeding right after birth, check blood glucose within 2-3 hours after birth.
   - Glucose ≥45
     - Check blood glucose immediately.
     - Glucose <30
       - Notify LIP while proceeding with algorithm.
       - Recheck glucose at bedside using NovaStatStrip (venipuncture) or STAT (heel-stick or venipuncture); send for STAT (do glucose only if bedside retaking can’t be done as described). If glucose is ≥45, return to appropriate box above. Otherwise, proceed with algorithm.
     - Glucose <45
       - Give dextrose IV @2 ml/kg IV push
       - Then start D5W @80 ml/kg/day

4. Symptomatic
   - Check blood glucose immediately.
   - Glucose ≥45
     - Notify LIP, Search for other etiology.
   - Glucose <45
     - Notify LIP while proceeding with algorithm.
     - Recheck glucose at bedside using NovaStatStrip (venipuncture) or STAT (heel-stick or venipuncture); send for STAT (do glucose only if bedside retaking can’t be done as described). If glucose is ≥45, return to appropriate box above. Otherwise, proceed with algorithm.

- **Asymptomatic WITH risk factors**
  - Check blood glucose at least 30 minutes after conclusion of feeding, but no later than 4 hours of age. If baby wasn’t interested in feeding right after birth, check blood glucose within 2-3 hours after birth.
  - Glucose ≥45
    - Check blood glucose immediately.
    - Glucose <30
      - Notify LIP while proceeding with algorithm.
      - Recheck glucose at bedside using NovaStatStrip (venipuncture) or STAT (heel-stick or venipuncture); send for STAT (do glucose only if bedside retaking can’t be done as described). If glucose is ≥45, return to appropriate box above. Otherwise, proceed with algorithm.
      - Glucose <45
        - Give dextrose IV @2 ml/kg IV push
        - Then start D5W @80 ml/kg/day

- **Glucose ≥45 (continued)**
  - Recheck glucose in no more than 30 minutes
  - Glucose ≥45
    - Continue IV and wean as tolerated.
    - Some at-risk babies may develop late hypoglycemia, often between 17 and 24 hours of age. Follow clinically and recheck glucose every 6 hours, before feeding, for the first 24 hours of life.
  - Glucose <45
    - Continue feeding.
    - Some at-risk babies may develop late hypoglycemia, often between 17 and 24 hours of age. Follow clinically and recheck glucose every 6 hours, before feeding, for the first 24 hours of life.

- **Glucose <45 (continued)**
  - Recheck glucose in no more than 30 minutes
  - Glucose ≥45
    - Continue IV and wean as tolerated.
    - Some at-risk babies may develop late hypoglycemia, often between 17 and 24 hours of age. Follow clinically and recheck glucose every 6 hours, before feeding, for the first 24 hours of life.
  - Glucose <45
    - If glucose remains <45, notify LIP to request Neonatology consult. Discuss further therapy and discuss transport to a high-level neonatal unit.
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<th>DATE</th>
<th>TIME</th>
<th>CHEMSTRIPS</th>
<th>SERUM GLUCOSE IN LAB</th>
<th>PHYSICIAN ORDERS</th>
<th>INTERVENTIONS</th>
<th>ADDITIONAL GLUCOSE and LABWORK</th>
<th>NURSING</th>
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<td>Chem strips q 1 hr X 3 then q 4 hrs if normal. D10 W 9.5cc IVP now then D10W at 15cc/hr peripheral IV. NPO.</td>
<td>RN 1450-bolus D10W 9.5 cc</td>
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<td>1620-Increase IV rate to 20cc/hr. Check chemstrip in ½ hr. 1630-D15W to run at 15cc/hr.</td>
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<td>Blood glucose STAT.</td>
<td>Chemstrip in 1/4 hr.</td>
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<td>Chemstrip in one hour</td>
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<td>0545: Start on po feedings 15cc q 3 hrs. f tolerated x2 1/2 IV to 30cc 3 hrs then to 45cc q 3 hrs every other feeding. If tolerated 15cc q 3 hrs x2 1/2 IV to 14.5cc/hr provided chemstrip remains &gt;=50.</td>
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<td>May start PO/NG feeding gradually &amp; adjust IVF as follows if chemstrip &gt;45-50.</td>
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<td>1500-RN progress note change IVF to D12.5W + lytes 6cc bolus</td>
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<td>1530-RN note PIV slightly swollen + blood return.</td>
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**Blood culture negative**

**Bili indirect: 8.3, Neonatal Bili: < 0.1, Bili Total: 8.3**

**Gent trough: 1.8, Gent peak: 6.6**

**0630 IV start M.O., RN 0700-1530 B.D., RN**

**RN note PIV sl more swollen, tender to restart. RN charting D: 12.5 IVF**

**2230, New IV start L ankle PIV #2**

**2230 IV started by P.B., RN**

**329/0000**
<table>
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<tr>
<th>DATE</th>
<th>TIME</th>
<th>CHEMSTRIPS</th>
<th>SERUM GLUCOSE IN LAB</th>
<th>PHYSICIAN ORDERS</th>
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<th>ADDITIONAL GLUCOSE and LABWORK</th>
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<td>1100</td>
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<td>1120 D10W to run at 18cc/hr and wean rate as previously ordered.</td>
<td>no growth after 2 days</td>
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<td>RN decreased IVF rate to 18cc/hr of D12.5 IVF still</td>
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<td>1445 Continue current IV (D12.5W with additives) @ 17cc/hr.</td>
<td>NPO, Repeat chemstrip in one hour.</td>
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<td>Urine culture negative no growth after 2 days</td>
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<td>No po feeding. 6cc of D12.5W by ?. Increase IVF to 18cc/hr. Chemstrip @ 1515. 1515-Repeat chemstrip in one hour.</td>
<td>RN charting D10W IVF at 18cc/hr</td>
<td>1500-2330 J.H., RN</td>
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<td>1610- ↑IV to 19cc/hr. Repeat chemstrip in one hour.</td>
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<td>RN charting D10W IVF at 16cc/hr</td>
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<td>RN charting D10W V/F at 140cc/hr</td>
<td>0600 RN note D10W 8cc IV bolus as soon as IV restarted. 0600-RN note PIV condition IV therapy started to restart PIV. 0610 RN therapy here.</td>
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<td>RN IV rate to 12cc/hr</td>
<td>0640-8cc IV bolus D10W IV charted as D10W @ 15cc/hr</td>
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<td>1045-RN charting IVF D15W @ 15cc/hr</td>
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<th>SERUM GLUCOSE IN LAB</th>
<th>PHYSICIAN ORDERS</th>
<th>INTERVENTIONS</th>
<th>ADDITIONAL GLUCOSE and LABWORK</th>
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<tr>
<td>1100</td>
<td>1145-18</td>
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<td>1145-RN D10W 9.5cc</td>
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<td>1200</td>
<td>1245-22</td>
<td>1226-31</td>
<td>D10W 9.5cc slow IVP in ½ hr.</td>
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<td>IVF rate 20cc/hr.</td>
<td>1245-D10W 9.5 cc</td>
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<td></td>
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<td>Chemstrip ½ hr after bolus infusion.</td>
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<td>Serum glucose now.</td>
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<td>1255-Increase D15W to 20cc/hr IV.</td>
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<td>D10W 9.5cc slow IVP in ½ hr.</td>
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<td>1743-36</td>
<td>1725-Stat glucose.</td>
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<td>1815-36</td>
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<td>1820-Solu- Cortef 5 mg q 6 hrs IVP.</td>
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<td>1915-RN note labs ordered Dr. G. sent.</td>
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<td>LABORATORY RESULTS</td>
<td>NURSING ACTIONS</td>
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<td>1951</td>
<td>1993</td>
<td>2000</td>
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<td>2300</td>
<td>2300-0730 J.O., RN</td>
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<td>37</td>
<td>331/0000</td>
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**Interpretation:**
- **Physician Orders:**
  - SERUM GLUCOSE IN LAB: May not feed 10:1500.
  - LAST CANDLER: NG 10:00.
  - Restart IV.

**Interventions:**
- RN 1 IVF rate to 24cc/hr.
- Bolus D10W 9.5cc IV.
- 2115-D15W to run at 24cc/hr IV.
- Chemstrip q 3
- Chemstrip q 3
- NG infusion cont.
- NG tube proximal to insertion firm IV removed restarted.

**Laboratory Results:**
- TSH 0.79
- T4 16.3
- T3 7.3
- Cortisol-PM 11.8
- Human growth hormone

**Nursing Actions:**
- Human growth hormone sent results to follow up.
- Resulted then as within 12.
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<td>0608-Decrease IV to 23cc/hr.</td>
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<td></td>
<td>1012</td>
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<td>Insulin, fasting ordered STAT specimen rejected Rejection reason: no specimen received</td>
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<td>D10W 8cc IVP.</td>
<td>Bill Indirect-6.5 Neonatal Bilirubin &lt;0.1 Total Bilirubin-6.5</td>
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<td>1117</td>
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<td>Insulin, fasting result to follow send out to Smithkline/Beecham Resulted then as 55H</td>
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<td>D15W to run at 25cc/hr. Decrease NG feeds to 5cc/hr.</td>
<td>Late entry at 1100 D10W 8cc IVP + glucose accu-check 15 minutes &amp; 1 hr after. Increase present IVF to 25cc/hr. Accu-check q 1 hr. 1215-present IVF to 26cc/hr.</td>
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<td>↑ hydrocortisone to 7 mg IV q 6 hrs 1st dose STAT. Continue hourly accu-checks.</td>
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<td>1400</td>
<td>1425-13</td>
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<td>1430-Insert UV line as emergency. 15cc D10 W UV push. Accucheck stat &amp; 10 minutes after. Run D15W IVF at 26cc/hr. Glucose water 10cc NG stat (late entry). Chest/abdomen XRAY for line placement. Glucose accu-check q 30 minutes X 2 then q 1 hr. Transfer to LUMC after mother consents for further management.</td>
<td>1415-IV infiltrated. 1420-NG out 1427-Umbilical line placed consent called Mom. 1430-UVC in NG back glucose infusions done. 1450-X ray done line placement.</td>
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<td>RN note LUMC transport team here pick up.</td>
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<td>4/2/2000</td>
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<td>Blood culture no growth after 6 days</td>
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<td>4/2/2000</td>
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<td>PKU/Metabolic Screen</td>
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<td>4/15/2000</td>
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<td>Illinois Department of Public Health reported all tests normal</td>
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Exhibit D
Hypoglycemia Case Study

Baby V was born on July 9, 0000. The mother of baby V (age 40 at the time of delivery) developed gestational diabetes during this, her first, pregnancy. The gestational diabetes was well controlled with a combination of diet and the oral medication Glyburide. Ms. V’s due date was July 15, 0000. She came to the hospital at term (39 weeks, 1 day gestation) and had her labor induced. The fetal monitor tracings revealed repetitive late decelerations, which are decreases in the fetal heart rate indicative of fetal hypoxia (low oxygen). Accordingly, a cesarean section was performed.

Baby V was born at 19:30 on July 9, 0000. He weighed 7 lbs 3 oz (3,260 grams). Moderate meconium (fetal stool that can be a marker during labor for fetal distress) was found during the cesarean section when the amniotic sac (the membranes covering baby V) was ruptured, and a moderate amount of meconium was suctioned from baby V’s mouth and stomach at birth. However, baby V’s APGAR scores (gross assessment of a newborn’s well-being after delivery) at one and five minutes were eight and nine out of a possible ten. Taken as a whole, the combination of repetitive late decelerations, meconium and solid APGAR scores indicates that, while baby V was somewhat hypoxic during labor and delivery, he has sufficient reserves (compensatory mechanisms) to overcome the hypoxia such that he had not suffered any brain injury prior to birth.

After delivery, baby V was transferred to the well baby nursery. Because of Ms. V’s gestational diabetes, the “IDM (Infant of diabetic mother)” protocol was initiated for monitoring baby V’s blood sugar during the first 24 hours of life. Pursuant to the protocol, baby V’s blood sugar level was to be checked at least four times during those first 24 hours. The reason for the protocol was that it is well known that infants of diabetic mothers can develop very low blood sugar levels shortly after birth, for several reasons. First, while in utero, the fetus makes more insulin than normal in response to the higher than normal level of glucose (sugar) in the mother’s blood that circulates to the fetus through the placenta. Once the baby is born, he may still have a high level of insulin remaining in his blood for a period of time response, even though he is not diabetic, and does not have an elevated blood sugar level. The net effect would be to drive the glucose level down dramatically. By the same mechanism, Glyburide, which is given to the mother during pregnancy to lower the blood sugar, can cross the placenta, and enter the fetal circulation. After birth, residual Glyburide can lower the baby’s blood sugar by the same mechanism as residual elevated insulin. In addition, infants of diabetic mothers are notoriously poor feeders. They commonly do not latch on to the breast well, and do not suck well, which can result in potential inadequate nutritional intake, which can also result in dangerously low blood sugar levels. If a baby’s blood glucose level drops low enough, the baby can develop respiratory distress, seizures, permanent brain damage and/or death.

According to the hospital’s policy and procedure in effect at the time, blood glucose levels below the cut-off of 45 called for supplementation and certain additional steps.
Baby V’s blood sugar levels were 45 at one hour, 45 at four hours, 66 at six hours, 65 at twelve hours, and 47 at twenty-four hours.

The plan was for baby V to be breastfed. The hospital’s policy and procedure called for breastfeeding babies to nurse at the breast every one and a half to three hours for duration of at least ten minutes per breast. Mothers of babies who were supposed to be breastfed, who were not successfully breastfeeding, were to be instructed on the use of the electric breast pump within six to twenty-four hours. The medical records reflect that baby V was not breastfeeding well beginning on the first day of life. Accordingly, he required supplementation with formula at 12:15am. and 5:30am. on July 10, 0000. Nurse A, a lactation consultant assessed Ms. V on July 10, 0000. Nurse A the lactation specialist, was not successful in facilitating initiation of breastfeeding, and was asked to leave by Ms. V, who was upset by the baby’s failure/inability to breastfeed, and by what she perceived as Nurse A’s physically rough treatment and handling of the baby and her.

At 01:00 on July 11, 0000, baby V’s weight was measured at 3,000 grams, which represented a weight loss of 7.8% from his birth weight of 3260 grams. While babies can lose some weight (typically fluid shift) during the first week of life, a weight loss of 7.8% at 29-30 hours is considered significantly greater than normal. The hospital’s policy and procedure stated that, if there is a weight loss of 7%, supplemental feeding should be given under a variety of circumstances, including the baby being lethargic and not nursing vigorously enough to empty the breast. According to the records, at 06:00 on July 11, 0000 (five hours after the weight loss was noted, Ms. V reported that baby V did not want to breast-feed. Baby V was supplemented with formula at 01:00 and 04:30 on July 11, 0000.

Several notations were made on the nursing flow sheet for July 11, 0000, reflecting time spent by baby V at his mother’s breast. There are also several chartings of LATCH scores, which pertain to some, but not all of the time frames noted on the flow sheet. A LATCH score is a compilation of five criteria that measure how effectively a baby can initiate a feeding. They do not measure the duration, amount or overall effectiveness of a breastfeeding attempt. The LATCH scores appear satisfactory as to the initiation of breastfeeding. However, the time frames that correspond with at least two of the three LATCH scores recorded show insufficient time, even if baby V was on his mother’s breast during those times, to constitute effective feedings.

Moreover, Ms. V specifically recalls her son was not breastfeeding effectively at any time from birth through and including the time of baby V being taken from her on the morning of July 12, 0000. Her breasts were blistered and painful from the unsuccessful feeding attempts. Her recollection is corroborated in several locations in the medical records.

At 00:15 on July 12, 0000 baby V’s weight was measured at 2900 grams, which constituted a weight loss of approximately 10.4% (approximately .75 lbs) since birth. The hospital’s policy and procedure when weight loss is at or greater than 10% required
giving 20-30 ml of formula and/or expressed breast milk after every other feeding, at least four to six hours or as ordered by the healthcare provider, and that mothers be started on electric breast pumps. Ms. Jones, RN, the nurse who was taking care of baby V on that shift and who recorded the 10.4% weight loss, noted that 15 ml of formula was given at 01:20. Ms. Jones, RN further noted that baby V was not able to breast-feed at that time. During the remainder of Ms. Jones’ RN shift until 07:30 a.m., baby V had no further food intake of any kind. Ms. V was not started on the breast pump at that time.

Shortly before 07:00, a phlebotomist came to baby V’s room to draw blood to check an ordered bilirubin level. At that time, Ms. V noticed that baby V did not cry when the phlebotomist stuck his heel. Inspection by the phlebotomist indicated that baby V was not breathing. The phlebotomist testified that she called for help. Nancy, another nurse on the postpartum floor, responded. Baby V was taken back to the well baby nursery. A bedside glucose check moments later revealed a level of 15 (severely low). Pulse oximetry showed an oxygen saturation of 85% (normal is 95% or more, and less than 90% is of significant concern). At 07:15, seizure activity was observed. Baby V was transferred to the NICU (newborn intensive care unit). At 07:15.

Baby V was first given an intravenous bolus of glucose at 07:25, 25 minutes after he was observed to be dusky and not breathing, more than 20 minutes after the glucose level of 15 was noted and 15 minutes after his first seizure. Thereafter, baby V’s blood glucose level was found on further testing to have dropped as low as seven.

Work-up while baby V was in the NICU showed no evidence of infection or a metabolic abnormality. Follow-up metabolic testing done at a large academic facility was also negative. An MRI of the brain showed bilateral occipital infarction (death of tissue in the area toward the back of the brain, a lesion that is commonly associated with severe hypoglycemia).

Baby V was discharged home from the NICU on July 24, 0000. Since that time, he has not developed normally. Baby V is currently two years and ten months old. He cannot walk, crawl or use his arms, legs or hands purposefully. He has no speech. Baby V experiences seizures on a daily basis, despite being on significant doses of anti-seizure medications. Because of his inability to swallow safely, baby V had a gastrostomy tube placed approximately one year ago, and now takes all of his feedings via the tube. He continues to live at home with his parents and family providing around the clock care for him on extremely limited resources.