Preparing for Unplanned Admissions to the NICU

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Abstract

An admission to the neonatal intensive care unit (NICU) may be planned if problematic maternal or fetal conditions have been identified during the pregnancy. However, in other instances, an unplanned admission to the NICU may happen because of unexpected maternal, fetal, delivery, or post-delivery conditions. In the United States, the number of admissions to the NICU continues to rise, with most infants presenting as preterm, with a low birth weight or with a clinical condition requiring specialized care. In addition, in the past two decades, more information has become available on the unique risks and treatment needs for infants identified as late preterm (34 0/7 to 36 6/7 weeks' gestational age).

Providers in Pennsylvania asked the Pennsylvania Patient Safety Authority to review and report conditions and trends related to unplanned admissions to the NICU that have been identified from submitted reports. In response to this request, Pennsylvania Patient Safety Reporting System (PA-PSRS) data was analyzed at five-year intervals (2006, 2011, and 2016), which included 3,385 reports. Of these reports, 95.5% (n = 3,231) were submitted as Incidents that resulted in no patient harm. Analysis of PA-PSRS data revealed that both premature and term infants experienced unplanned admissions to the NICU. Admissions to the NICU generally increased during the reporting period, and a single event report may describe multiple associated conditions. The most frequently reported conditions related to an unplanned admission to the NICU were respiratory distress (29.5%), metabolic issues such as hypoglycemia and hyperbilirubinemia (16.2%), prematurity (9.5%), neonatal abstinence syndrome (NAS; 7.6%), and infection (6.1%).

Introduction

An unplanned admission to the neonatal intensive care unit (NICU) may happen because of unexpected maternal, delivery, or fetal conditions. Admissions to the NICU continue to rise in the United States, with 500,000 infants born annually as preterm, with low birth weight, or having a clinical condition that requires specialized care. Care in the NICU, which focuses on supporting organ development and providing necessary assessment and treatment by specially trained staff, has reduced newborn mortality and morbidity over the past 40 years. Providers in Pennsylvania asked the Pennsylvania Patient Safety Authority to review and report on conditions and trends resulting in an unplanned admission to the NICU identified from submitted reports.
Methods

Analyst queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database for events involving patients younger than 12 months of age reported for the years 2005 through 2016. The search criteria used to identify events involving an unplanned admission to the NICU included the "unplanned admission to the NICU" event subtype as well as events that contained the following key words in the narrative details: nicu, transfer, gest, premature, term, diabet, maternal, and mecon. Use of a wildcard character (*) ensured that the search yielded events containing multiple word forms (e.g., diabet* returns both diabetes and diabetic).

The analysis was limited to sampling full years at five-year intervals: the years 2006, 2011, and 2016. A manual review of these reports was completed and reports were included if the event type was "unplanned transfer to the NICU" or the narrative detail stated a transfer to the NICU, ICU, or higher level of care occurred. Further manual analysis was completed to identify the conditions associated with the unplanned admission to the NICU event, gestational age if noted, and trends over time. A single event could contain more than one condition associated with the unplanned admission to the NICU.

All reports that identified an event in which the NICU physician, resident, or nurse was summoned to a delivery or for a consultation that did not result in an unplanned admission to the NICU were excluded. Also excluded were reports that described situations in which the patient was admitted to the NICU postoperatively per surgical plan or in which the report category or narrative detail did not identify the NICU admission as unplanned.

Results

In years 2005 through 2016, healthcare facilities reported 18,085 events potentially involving an unplanned admission to the NICU to the Authority. The pre-manual review identified 4,780 reports of potential unplanned admissions to the NICU (2006, n = 659; 2011, n = 1,717; and 2016, n = 2,404).

A total of 1,395 events were excluded, leaving 3,385 reports for further analysis (2006, n = 430; 2011, n = 1,321; and 2016, n = 1,634). Of these reports, 3,231 (95.5%) were submitted as Incidents that resulted in no patient harm. The conditions associated with an unplanned admission to the NICU are shown in Figure 1. In addition, 248 reports included gestational age, and although the differences between the years are small, the age range most frequently having an unplanned admission to the NICU was late preterm. This information is summarized in Figure 2.
The following is a sample of respiratory complication events reported to the Authority.*

http://patientsafety.pa.gov/ADVISORIES/Pages/201712_NICU.aspx
Infant Girl born via C-section at 39 weeks’ gestation. NICU staff at delivery. Upon rupture of membranes during the C-section there was very thick meconium in the fluid. Infant stimulated and bulb syringe for resuscitation after spontaneous crying. Infant retreating with intermittent grunting, had a copious amount of meconium stained secretions. Infant was deep suctioned for 6 cc of dark meconium stained fluid, which decreased the retractions. NICU was called back at 43 minutes of life because of retractions, worsening of grunting, and nasal flaring. NICU came back, gave continuous positive airway pressure (CPAP) for 1 minute. Pulse oximetry within normal limits. Stated more air was moving in lungs, but still diminished. NICU called at 70 min of life for respiratory status not improving. It was then decided infant would be transferred to NICU.

Patient was delivered via C-section at 26 5/7 weeks’ gestation. Complications of pregnancy included pre-eclampsia and intrauterine growth restriction. Patient was intubated after delivery due to respiratory failure. Patient self-extubated and converted to synchronized inspiratory positive airway pressure, with no re-intubation required.

The following is a sample of a hypoglycemia event reported to the Authority:

Infant born to insulin dependent gestational diabetic mother. Infant's blood sugar upon birth was 33. Post breastfeed sugar was unchanged. Infant fed 18 mL Similac formula via bottle and his after-feed sugar was 34. NICU PA-C aware of infant blood sugars and axillary temp of 97.2°F, infant transferred to NICU for low blood sugars.

The following is a sample of a neonatal abstinence syndrome (NAS) event reported to the Authority:

36-week gestation infant delivered weighing 5 lb, 6 oz.; exhibiting signs of withdrawal. Oxycodone noted in mother's toxicology screen. Infant transitioned to darkened nursery, swaddled, decreased stimuli in efforts to reduce withdrawal symptoms. Withdrawal symptoms continued. Infant transferred to NICU for management of NAS.

The following is a sample of an infection event reported to the Authority:

Newborn at 39 weeks and 1 day gestation. Baby had low temperature and upon recheck was lower. Nurse reported cloudy amniotic fluid in report. Provider suspects possible sepsis. Baby is being transferred to NICU.

The following is a sample of a late preterm infant event reported to the Authority:

34-week preterm gestation in preterm labor. Infant born via C-section and developed respiratory distress and possible sepsis. Patient transferred to NICU.

* The details of the PA-PSRS event narratives in this article have been modified to preserve confidentiality.

**Discussion**

PA-PSRS data revealed that both preterm and term infants experienced unplanned admissions to the NICU. During the sampled dates between 2006 and 2016, the most common reasons for unplanned transfer to the NICU were respiratory distress, hypoglycemia, and prematurity. The number of reports of NAS, gastrointestinal/feeding issues and infection also increased over those dates.

Facilities that provide birthing services must be prepared to promptly recognize problems and intervene to reduce morbidity and complications. The NICU provides neonates with specially trained medical, nursing, and support staff along with advanced technology to monitor and treat the compromised infant. A multidisciplinary NICU team includes neonatologists, pediatricians, fellows, residents, registered nurses, nurse practitioners, respiratory therapists, occupational therapists, dieticians, lactation consultants, pharmacists, social workers, and chaplains.1
Factors that can place an infant at increased risk of being admitted to the NICU can be related to the following maternal, delivery, or infant issues\textsuperscript{1,2,5-11}:

Maternal conditions:
- Advanced maternal age
- Diabetes
- Hypertension
- Amniotic fluid problems
- Chorioamnionitis
- Drug and alcohol use
- Black/non-Hispanic mothers with private insurance

Delivery conditions:
- Fetal distress
- Breech delivery
- Meconium aspiration
- Nuchal cord
- Use of forceps
- Cesarean section (C-section) delivery
- Preterm labor and premature rupture of membranes (PTL/PPROM)

Fetal conditions:
- Young gestational age
- Low birth weight
- Birth defects
- Respiratory distress due to the following: respiratory distress syndrome, apnea, bronchopulmonary dysplasia, pneumonia, transient tachypnea of the newborn (TTNB), pneumothorax, pulmonary hemorrhage, pleural effusion, congenital or surgical anomalies; need for supplemental oxygen, CPAP, or mechanical ventilation requirement
- Cardiac: bradycardia, patent ductus arteriosus, tetralogy of Fallot, septal defects, coarctation of the aorta, transposition of the great arteries
- Infection: sepsis, necrotizing enterocolitis
- Seizures
- Hypoglycemia
- Asphyxia
• Intracranial hemorrhage, intra or periventricular hemorrhage
• Congenital anomalies
• Jaundice
• Temperature instability
• Other clinical conditions requiring increased monitoring and services at birth

**Respiratory System Conditions**

Respiratory conditions are the most common reason for admission to the NICU in both term and preterm infants, as noted in PA-PSRS data and the literature.\(^1\)

Lung immaturity can make the transition from intrauterine to extraterine life difficult for a preterm or late preterm infant. Surfactant production starts at about 24 weeks' gestation and alveolar development, which allows the infant to expel lung fluid upon birth, begins at about 32 weeks' gestation. If the infant cannot clear this fluid, TTNB may develop.\(^9\) Lack of surfactant combined with alveolar immaturity can leave the infant unable to fully oxygenate, causing respiratory distress syndrome.\(^9\)

In addition, the term infant can also experience respiratory conditions such as meconium aspiration, pulmonary hypertension of the newborn, pleural effusion, surfactant protein deficiency, and alveolar capillary dysplasia.\(^6,12\) TTNB usually resolves by 72 hours in term infants.\(^2\)

Congenital and surgical anomalies such as pulmonary airway malformation, diaphragmatic hernia, lobar emphysema, choanal atresia, trachea-esophageal fistula, and pulmonary sequestration can cause respiratory problems. Nonrespiratory conditions such as heart failure, neuromuscular disorders, hypoxic ischemic encephalopathy, and metabolic acidosis can also lead to respiratory distress.\(^6\)

The NICU care team must be skilled at recognizing the signs of respiratory compromise to ensure that appropriate assessments, diagnosis, and management—including transfer to the NICU—are put in place promptly.\(^6\) Infants with respiratory distress may exhibit grunting, tachypnea, sternal retraction, and nasal flaring. Oxygen saturation may be reduced and the infant may become pale or cyanotic. Chest x-rays can help clinicians differentiate between respiratory distress syndrome and pneumonia. Other studies may be performed to see whether infection or a metabolic issue might be the underlying cause of the distress.\(^6,8\)

It might be necessary to prevent hypoxia through ventilatory support. Strategies to reduce lung injury, including less aggressive ventilation are more common now, as is administration of surfactant therapy. Less invasive methods of ventilation such as nasal synchronized intermittent mandatory ventilation is used with CPAP, offering a higher level of support.\(^13\) The utilization of surfactant therapy increased from 40% to 80% in infants born between 22 and 28 weeks' gestational age from 1993 to 2011.\(^13\) Stoll and co-authors performed a prospective study of these infants with birth weights of 401 to 1,500 g, born at 26 network centers between 1993 and 2012 and found that use of antenatal corticosteroids increased from 24% to 87% and C-section deliveries increased from 44% to 64% during the study period. Delivery room intubation of these neonates decreased from 80% to 65%.\(^13\)

Fetal distress during labor can cause meconium to pass into the amniotic fluid before the infant is delivered.\(^6\) When the infant inhales the meconium, mechanical obstruction of the airway, chemical pneumonitis, and infection can occur.\(^6,8\) Meconium aspiration syndrome (MAS) is mostly treated with supportive therapy until the lung inflammation resolves.\(^6\)

In March 2017, the American College of Obstetricians and Gynecologists (ACOG) published a committee opinion
regarding management of the newborn with meconium-stained amniotic fluid. ACOG recommended the following:

*Infants with meconium-stained amniotic fluid, regardless of whether they are vigorous or not, should no longer routinely receive intrapartum suctioning. However, meconium-stained amniotic fluid is a condition that requires the notification and availability of an appropriately credentialed team with full resuscitation skills, including endotracheal intubation. Resuscitation for infants with meconium-stained fluid should follow the same principles as for those with clear fluid.*

**Metabolic Conditions**

Hypoglycemia was the second most common reason for an unplanned admission to the NICU per PA-PSRS data.

Certain conditions, such as maternal diabetes, maternal obesity, and fetal distress during labor and delivery may predispose the infant to hypoglycemia. Other risk factors include intrauterine growth restriction, infection, low Apgar score at 5 minutes, and infants who are large for gestational age. The late preterm infant is at risk for hypoglycemia due to smaller glycogen stores and an immature hepatic system. An infant with hypoglycemia may exhibit several clinical signs, including irritability, jitteriness, seizures, lethargy, floppiness, and difficulty with feeding.

The primary treatment for hypoglycemia is supporting feeding, especially breastfeeding. If blood glucose is less than 40 mg/dL, treatment with dextrose may be ordered, as well as considering transferring infant to the NICU. Monitoring serial blood glucose levels timed around feeding attempts is necessary until the infant's condition has stabilized. Other systemic conditions that may influence glucose regulation may also be considered.

Hyperbilirubinemia was less commonly reported. Hyperbilirubinemia is present if the infant is unable to break down and eliminate bilirubin through the urine and stools. Infants with hyperbilirubinemia may exhibit jaundice, a yellow discoloration of the infant's skin and sclera. A preterm infant (36 weeks' gestational age) has six times the chance of having elevated serum bilirubin, compared with a term infant (40 weeks' gestational age). Preterm and late preterm infants are at increased risk due to several factors such as poor feeding effort and lower levels of the uridine diphosphate glucuronyl transferase, a bilirubin-conjugating enzyme. In addition, preterm and late preterm infants pass meconium more slowly than their term counterparts, which delays clearance of bilirubin via the stool.

Failure to diagnosis and treat hyperbilirubinemia can lead to kernicterus, a severe neurological event. Total serum bilirubin (TSB) may peak at four days for a term infant, but the peak will be delayed in the preterm and late preterm infant. Treatment to clear the excess bilirubin includes supporting feeding so the infant stays hydrated, increases stool volume, and passes meconium and stool. Phototherapy may be used to provide photo-oxidation to help the liver break down the excess bilirubin in the blood.

**Neonatal Abstinence Syndrome**

NAS is present when infants exposed to prescription or illicit medications in utero exhibit symptoms of withdrawal. Current PA-PSRS data shows that in Pennsylvania between 2011 and 2016, the number of reports of unplanned admissions to the NICU due to NAS more than doubled, and this is consistent with PA-PSRS data previously reviewed.

The national incidence of NAS doubled between 2009 and 2012, and infants with NAS account for 4% of NICU admissions. Infants admitted to the NICU with NAS have an average length of stay of 40 to 50 days, especially when the infant requires pharmacologic treatment.

Infants with NAS can exhibit tremors, high-pitched crying, convulsions, tachypnea, difficulty with feeding, diarrhea, and other problems. Diagnosis assesses toxicology-screening results of maternal and infant urine and meconium and observations made using a selected tool, such as the Finnegan or Lipsitz scoring system. The Finnegan scoring system is most commonly used and rates four areas: central nervous system irritation, respiratory distress, developmental delay, and feeding problems.

http://patientsafety.pa.gov/ADVISORIES/Pages/201712_NICU.aspx
gastrointestinal (GI) distress, and vegetative symptoms. Assessment and scoring is begun within the first 24 hours of
birth and continued every three to four hours, with a score of eight or more requiring increased monitoring and
intervention.19

Treatment for NAS can be both pharmacologic and nonpharmacologic. Medications are used for moderate to severe
NAS. Morphine or methadone is used as first-line treatment.18,25,26 Phenobarbital or clonidine may be used, if needed,
in conjunction with first line-medications.19,25,26

Nonpharmacologic treatment includes breastfeeding support and other methods to encourage sucking.18,19 Other
methods employed include providing a calm environment for the infant, such as swaddling the infant and keeping the
room quiet and dark. Parental education should provide the parents with skills to maintain an environment to soothe
the infant.18,19

**Infection**

According to PA-PSRS data, reports of infection as a cause associated with an unplanned admission to the NICU
increased 300% over the past 10 years.

Infants are susceptible to infections as they transition to life outside the uterus, and preterm infants are four times as
susceptible as term infants.8 The placental barrier provides protection from infection, and the maternal immune
substances stored in the fetal tissue in the last few weeks of gestation provide the infant with passive immunity
against many infections.10 Infection or sepsis can occur prenatally from the mother's blood or during labor if the infant
ingests or aspirates infected amniotic fluid.8 Maternal conditions that put the infant at a higher risk for developing an
infection include lack of prenatal care, substance use, maternal infections such as a urinary tract infection or
chorioamnionitis, and premature rupture of membranes or preterm labor.2 Infection that progresses systemically to
sepsis in the neonate is classified as early or late onset. Early-onset sepsis (EOS) typically occurs in the first three
days of life, caused by maternal transfer either in utero or during delivery.8,27 Preterm infants are highly susceptible to
EOS and pneumonia because preterm delivery has been associated with maternal bacterial pathogens, which are
frequently gram-negative organisms such as group B streptococcus (GBS).2,27 Nationwide, prophylactic maternal
antibiotic use has decreased the incidence of EOS due to GBS.28 Mortality is high for very low birth weight infants
(less than 1,500 g), and 20% of deaths in this population are from sepsis.27

Late-onset sepsis occurs after three days of life, is primarily nosocomial, and is frequently caused by a gram-positive
pathogen.8,27 Bacterial infection can occur through sites such as the umbilical stump; mucus membranes of the
eyes, ears, nose, and throat; and the respiratory, nervous, urinary, and GI systems.10 Late-onset sepsis is frequently
a complication of very premature infants, with *Staphylococcus aureus* frequently being the dominant pathogen.28

Recognizing infection can be challenging because symptoms of systemic infection can be nonspecific and may mimic
symptoms of other health issues. Staff must be alert to subtle changes in the infant's clinical appearance and
behavior.2 The infant may exhibit circulatory changes, such as cold, clammy, or mottled skin, with hypotension and
either bradycardia or tachycardia. Respiratory clinical signs may include dyspnea, apnea or tachypnea, cyanosis,
grunting, or retractions. Central nervous findings may include diminished or increased movement and tone. Feeding
problems along with vomiting, diarrhea, abdominal distention, hepatomegaly, or blood in the stool may indicate
infection.8

In addition to ongoing physical assessment, laboratory studies including cultures of the blood, urine, and cerebral
spinal fluid (CSF) are used to determine the focus of infection and the specific pathogen to be treated. Treatment for
infection will include medication (based on the organism), maintenance of fluid and electrolyte balance, appropriate
oxygenation, and continual monitoring.2 Factors that reduce the incidence of late-onset sepsis for infants in all
gestational ages include maintaining strict infection-prevention practices, hand hygiene, and skin care; encouraging human milk feeding; and employing good catheter insertion and care practices and discontinuing invasive devices when not needed.\textsuperscript{2}

Necrotizing enterocolitis (NEC) is an inflammatory disease of the bowel resulting in ischemic changes to the bowel. It affects very low birth weight infants more frequently, with about 10\% to 15\% developing this condition and up to 50\% of these infants requiring a surgical procedure. Mortality is high, with about 34\% of infants who develop NEC dying of this condition and its associated complications. Infants with NEC have a higher incidence of bloodstream infections and neurological injuries.\textsuperscript{2,29} The exact cause of NEC is unknown, but multiple risk factors such as prematurity and low birth weight put the infant at a higher risk.\textsuperscript{2}

NEC is most commonly seen between 3 and 12 days of life. Clinically, the infant may exhibit GI symptoms such as abdominal distention, tenderness, decreased or absent bowel sounds, bilious emesis, blood in the stools, and difficulty feeding. Other clinical signs may include respiratory distress, lethargy, and hypotonia.\textsuperscript{2,29} Abdominal x-rays along with laboratory studies (complete blood count [CBC], arterial blood gases, and blood cultures) help in diagnosing NEC. Severity of NEC is based on the stage: IA, IB, IIA, IIB, IIIA and IIIB.\textsuperscript{2} Medical NEC (stage IA to IIIA) can be treated with medication and support of the infant's metabolic, respiratory, and cardiac systems. Stage IIIB is considered a surgical condition, treated with procedures such as peritoneal drainage to decompress the abdomen, potentially followed by laparoscopy, ostomy creation, and bowel resection to remove necrotic bowel.\textsuperscript{2,29}

**Late Preterm Infants**

Prematurity can predispose infants to significant problems during the transition to extraterine life. Immature vital organs, such as the lungs, heart, GI tract, liver, and brain require support to ensure continued development.\textsuperscript{2,5,8} In the United States, about 500,000 infants are born annually preterm or with a low birth weight, and these infants comprise 70\% to 90\% of all infants admitted to the NICU.\textsuperscript{1,2,30} A time-trend analysis from 2007 through 2012 by Harrison and colleagues, across all U.S. live birth weights, found that during the study period, NICU admissions showed a relative increase of 23\%. Also, as that five-year period unfolded, infants admitted to the NICU were increasingly larger and less premature.\textsuperscript{4}

In the past two decades, attention has focused on the late preterm infant. In 2005, the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) agreed that this group of infants should be clearly defined. "Near-term" was replaced by "late preterm" for infants between 34 0/7 and 36 6/7 weeks’ gestational age.\textsuperscript{17,31-33}

Late preterm infants account for 75\% of preterm deliveries and 9\% of all overall deliveries in the United States.\textsuperscript{12,32} From 1990 to 2005, late-preterm-infant births increased by 24.5\%.\textsuperscript{12,31} Many factors can contribute to the increase of late preterm births, which include increased monitoring in the prenatal period, inaccurate gestational age assessment, changes in infertility treatments, increased multiple pregnancies with early deliveries, and increased elective inductions and C-sections.\textsuperscript{12,31}

The late preterm infant physically appears more like the term infant than the more premature infant. When late preterm infants were called "near-term," the impression was that they had similar risks of morbidity and mortality as their term counterparts, and their vulnerabilities may have been missed.\textsuperscript{17,31} Hospital protocol may dictate whether the late preterm infant receives care in the newborn nursery or in the NICU, and staff will need to be able to assess clinical issues and initiate transfer to a higher level of care. Discharge of late preterm infants may make them vulnerable for readmission if hospital policy allows these infants to be discharged early. Late preterm infants never
admitted to the NICU have an increased risk of being readmitted to the hospital after discharge when compared with term infants.\textsuperscript{12,17} Staff focus on appropriate discharge care planning and family support is necessary to avoid readmission.\textsuperscript{34}

Vulnerabilities of a late preterm infant are predictable, preventable, and manageable.\textsuperscript{17} Professional organizations such as the California Perinatal Quality Care Collaborative (CPQCC) and the National Perinatal Association have published toolkits and guidelines for the care and management of the late preterm infant\textsuperscript{6,35} and recommend that providers develop a plan of care to address these infants' vulnerabilities. Specific attention is recommended to reduce the risk of respiratory distress, hypothermia, sepsis, hypoglycemia, feeding difficulties, and hyperbilirubinemia while supporting breastfeeding and nutritional supplementation as needed.\textsuperscript{32}

Consider delaying discharge until at least 48 hours of age. Document overall stability for 24 hours before discharge, to include feeding competency and bilirubin level. Follow-up after discharge needs to occur promptly to ensure that the infant continues to thrive, is not experiencing signs of respiratory distress or hyperbilirubinemia, and has developed satisfactory feeding and elimination\textsuperscript{9,17,35}

**Conclusion**

PA-PSRS data revealed the most frequently reported conditions associated with reports of an unplanned admission to the NICU were respiratory distress, prematurity, hypoglycemia, NAS, gastrointestinal/feeding issues, and infection. Understanding the potential risks that infants at different gestational ages may experience—which may result in an unplanned transfer to the NICU—and being prepared to provide the appropriate care for the infant experiencing distress are necessary for organizations that provide birthing services.

Admissions to the NICU continue to rise in the United States, with most infants presenting as preterm, with a low birth weight, or with a clinical condition requiring specialized care. PA-PSRS data reflects this national trend, with reports of unplanned admission to the NICU rising over a fifteen-year period. In addition, the late preterm infant has received more attention in the past two decades as more information has become available on their unique risks and treatment needs. Professional organizations have developed toolkits and guidelines specific to this subset of premature infants to ensure appropriate plans of care are initiated.

**Notes**


15. Wisconsin Association for Perinatal Care (WAPC). Caring for the late preterm infant. A sample care plan for late preterm infants (gestational age 34 0/7 wks to 36 6/7 wks). Madison (WI): Wisconsin Association for Perinatal Care (WAPC); 2013 Mar. 7 p. Also available:


