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The S.T.A.B.L.E.® Program

The Evidence Behind the 2012 Update

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ABSTRACT

First released in 1996, the S.T.A.B.L.E.® Program has provided evidence-based education in the postresuscitation and pretransport stabilization care of sick newborns to more than a quarter million multidisciplinary perinatal healthcare team members from around the world. The program, aimed at preventing the leading causes of neonatal mortality, continues to be the subject of published peer-reviewed research and is periodically updated to ensure relevancy and inclusion of current best evidence. S.T.A.B.L.E. is a mnemonic for the 6 essential assessment parameters taught in the program: *S*ugar and *S*afe care, *T*emperature, *A*irway, *B*lood pressure, *L*ab work, and *E*motional support. This mnemonic was specifically chosen to serve as a memory tool to remind staff of "what to do" during those infrequent but stressful times when they were expected to assess and stabilize sick newborns. Course completion of the S.T.A.B.L.E. Program is obtained as a result of didactic training and successful completion of content testing. The program's test questions are periodically evaluated and revised on the basis of psychometric analysis. The 6th edition of the S.T.A.B.L.E. Program learner/provider manual is scheduled for release in 2012 and will reflect the latest in stabilization guidelines throughout the program's 6 modules and supplemental content.

Key Words: neonatal mortality, neonatal stabilization, neonatal transport education, postresuscitation stabilization, pretransport stabilization education

S.T.A.B.L.E. PROGRAM: HISTORY AND BACKGROUND

In 1996, a neonatal education program called the S.T.A.B.L.E.® Program was implemented in the United States to provide evidenced-based guidelines for the care of sick newborns requiring transport to a neonatal intensive care unit (NICU). The S.T.A.B.L.E. Program curriculum is intended for the entire perinatal healthcare team in any birth setting; the education focuses on situations and problems commonly encountered while providing postresuscitation care. The course is presented in an 8- to 9-hour didactic format, using supporting course materials including a PowerPoint presentation and student and instructor manuals.[1] Taught by experts in neonatal nursing or medicine, the S.T.A.B.L.E. mnemonic stands for the 6 essential assessment parameters taught in the program: *S*ugar and *S*afe care, *T*emperature, *A*irway, *B*lood pressure, *L*ab work, and *E*motional support. This mnemonic was specifically chosen to serve as a memory tool to remind staff members of "what to do" during those infrequent but stressful times when they were expected to assess and stabilize sick newborns in preparation for transport. Three additional modules have been added to the program since 2003: The S.T.A.B.L.E. Cardiac Module,[2] which focuses on the unique challenges presented by structural heart disease with emphasis on recognition and stabilization of neonates with severe congenital heart disease (CHD); a Physical Exam and Gestational Age Assessment module[3]; and a simulation-based education scenario guidebook.[4]

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The S.T.A.B.L.E. Program has grown rapidly since 1996 when the program was first taught, with current registered lead and support instructor enrollment at 3585 worldwide. From January 2001 (when the roster program was initiated to track student and instructor involvement) to December 2011, 250 881 students have earned a course completion card for successfully completing a Learner/Provider course. Currently, more than 35 000 students worldwide complete a Learner/Provider course each year.[5] After an extensive review by a neonatal panel, S.T.A.B.L.E. was endorsed by the March of Dimes in 2004, and in 2006, the American Academy of Pediatrics Section on Transport Medicine's executive committee recognized the S.T.A.B.L.E. Program with the following statement: "The S.T.A.B.L.E. course is the preeminent educational program for pre-NICU and transport team professionals alike on the essentials in the management of unstable neonates awaiting transport and NICU admission" (Dr Robert Insoft, MD, e-mail communication, October 12, 2006).

S.T.A.B.L.E. has been translated into Spanish, Latvian, Lithuanian, and Romanian languages, and a Vietnamese translation is in progress. The US Navy is entering its ninth year of instructor training for graduating pediatric residents and expert neonatal nurses so that S.T.A.B.L.E. may be taught in the military hospitals where Navy pediatricians are based. In addition, Air Force and Army facilities have participated in the Navy instructor training courses. A survey of S.T.A.B.L.E. lead instructors conducted in August 2011 revealed that neonates are more comprehensively stabilized and healthcare provider performance has improved following the S.T.A.B.L.E. Program implementation.[6]

Since 2003, the S.T.A.B.L.E. Program has stimulated a number of international research studies. A summary of these studies, by country and year of publication from newest to oldest, is described in the following paragraphs.

The United States

Members of a regional neonatal transport system network sought to determine how a "prompted" intervention performed by stabilization caregivers could improve methodical monitoring of infant blood glucose level during the period between resuscitation and initiation of transport to advanced care facilities.[7] The intervention is based on utilization of the Pre-transport Stabilization Self-Assessment Tool (PSSAT) that is integrated into the quality improvement module in the S.T.A.B.L.E. curriculum. Completion of the tool allows for self-evaluation of pretransport stabilization activities and physiologic condition of the neonate during the stabilization period. One parameter that is recorded on the PSSAT form is the glucose value. The glucose parameter was selected by the study authors for the evaluation of the PSSAT form. There are 3 time periods suggested for glucose data collection: first, at the time of the initial call requesting transport service; second, at the time the transport team arrives at the referring facility; and finally, just prior to departure of the patient and team. In some cases, a glucose evaluation may not be indicated at those time points; individual assessment of risk factors for hypoglycemia and prior glucose test results should occur to determine when an infant requires glucose testing.

Five referring hospitals that transferred neonates to facilities capable of delivering higher levels of care were included in the study. In June 2008, a retrospective medical record review of 134 neonates transported prior to PSSAT implementation was undertaken to obtain baseline data including blood glucose monitoring performed during stabilization, patient demographics, and primary diagnosis. Referring hospital perinatal staff and neonatal transport team members were subsequently educated as to the correct use of the PSSAT and also received education related to hypoglycemia, including potential neurodevelopmental sequelae of hypoglycemia. A total of 42 infants from the 5 referring hospitals were included in the study. In comparing the 2008 baseline data with that obtained during the study period (August 15, 2010, to January 15, 2011), the study authors concluded that the use of the PSSAT form prompted caregivers to perform regular glucose screening of infants being stabilized for neonatal transport.[7] A limitation of this study is that it is unknown whether any glucose values were below the S.T.A.B.L.E. glucose treatment parameter during the study period. S.T.A.B.L.E. glucose treatment parameters call for maintenance of values more than 50 mg/dL (2.8 mmol/L), as well as repeated measures of glucose until values are more than 50 mg/dL on 2 consecutive tests.[1] In addition, some of the variation in glucose measurement at the 3 time points may be explained by the presence of a normal glucose value and thus the clinical decision to avoid subjecting the infant to unnecessary and painful heel stick procedures.

Mexico

In a setting of recognized organizational and resource constraints, which are further complicated by geographical conditions and communication challenges, a group of providers and researchers in Guadalajara, Jalisco, Mexico, sought to improve outcomes for those preterm and ill newborns requiring transfer to tertiary-level care.[8] Physicians, nurses, and paramedics working in referring neonatal care hospitals and private clinics in the state of Jalisco, Mexico, received the S.T.A.B.L.E. Program education from physicians of the Mexican Association of Neonatologists. On successful written assessment and practice demonstration, these personnel were awarded S.T.A.B.L.E. certification.

Following implementation of the S.T.A.B.L.E. Program in January 2005, morbidity and mortality data were prospectively analyzed in infants transferred between 2005 and 2009 from non–tertiary-level neonatal care facilities and admitted to the NICU at the Civil Hospital in Guadalajara, Mexico. Data for the year preceding S.T.A.B.L.E. implementation were also retrospectively analyzed; nearly 3300 infants were studied, with approximately 400 infants included in the retrospective study and 2900 in the prospective study.

Outcomes and stabilization process data were evaluated pre– and post–S.T.A.B.L.E. education intervention. Statistically significant improvements were found for normal body temperature (59% preintervention vs 87% postintervention, $P < .01$), normal blood glucose level (45% preintervention vs 93% postintervention, $P < .001$), and infant mortality rate, which declined from 22% to 14% ($P < .05$). Following S.TA.B.L.E. education intervention, process improvements were also noted, including an increased number of patients transported in incubators (97% postintervention vs 52% preintervention, $P < .001$) and increased use of pulse oximetry monitoring (89% postintervention vs 61% preintervention, $P < .01$). The study authors strongly recommended the S.T.A.B.L.E. Program education for all referring medical and paramedical staff to reduce morbidity of transported neonates. The association between S.T.A.B.L.E. intervention and decreased infant mortality rate merits further evaluation.[8]

Panama

Panama is a Central American country with challenges similar to those encountered in Mexico with regard to provision of advanced care to preterm and ill infants born in remote and medically underserved locales. Two-thirds of Panama's annual births take place far from the tertiary-level care that is available in Panama City. As of 2008, Panama reported a live birth neonatal mortality rate double that of the United States. Nearly 30% of the admissions to the country's largest NICU at Hospital del Nino in Panama City are received via neonatal transport; the mortality rate of transported neonates is 3.5 times greater than for those infants born near the tertiary care center. Neonates are transported by ambulance from the birth location and accompanied by a physician, nurse, or auxiliary health officer.[9]

Personnel from 10 birthing centers that refer the majority of the country's neonates to Panama City were trained in the S.T.A.B.L.E. Program, using Spanish language materials. Using data from previous studies, sample size was determined for both a 1°C improvement in admission body temperature and an increase in serum glucose level of 15 units. A prospective pre- and postintervention study design was used. Data from 136 transported infants during an observation period prior to the S.T.A.B.L.E. education and from 146 infants following the S.T.A.B.L.E. education intervention were collected. The study was conducted over a period of 15 consecutive months, from November 2006 to January 2008.[9]

Primary outcome measures were serum glucose and body temperature upon admission to tertiary care. In the postintervention group, normothermia upon NICU admission, defined as a body temperature between 36.5°C and 37.5°C, was achieved in 56% of admissions versus 34% in the preintervention period ($P < .01$). Normoglycemia upon NICU admission, defined as a serum glucose level between 50 and 140 mg/dL, was not statistically different in the pre- and postintervention groups. Several study limitations were identified including variation in how and when body temperature was measured (rectal vs axillary, in the emergency department vs after admission to the NICU), field availability of glucose monitoring equipment, lack of control over glucose infusion rates and concentrations administered during transport, and uncertainty about whether S.T.A.B.L.E. training was provided to all staff members involved in the stabilization and transport of the study patients.

Canada

Province of Nova Scotia

Half of the population of Nova Scotia, Canada, is geographically located far from newborn tertiary care, thus requiring transport of all preterm and ill infants for advanced and specialized care. In Nova Scotia, the survival rate for outborn preterm infants weighing between 1000 and 1499 g is 67% compared with 93% for those of the same weight who are born at the IWK Health Centre tertiary referral center in Halifax, Nova Scotia.[10] Thus, there is significant need for pretransport stabilization education in Nova Scotia. From October 1999 to November 2000, 124 nurses, physicians, and respiratory therapists in Nova Scotia received the S.T.A.B.L.E. Program education. Researchers at the IWK Health Centre, which provides neonatal tertiary care to the provinces of Nova Scotia, New Brunswick, and Prince Edward Island, evaluated the impact of S.T.A.B.L.E. training on pretransport stabilization care and physiologic parameters of temperature, glucose, and blood pressure, as well as provider perceptions of the S.T.A.B.L.E. Program.[10]

The study was conducted in 2 phases over a 13-month period.[10] In phase 1, a questionnaire was provided to the 124 participants who had completed S.T.A.B.L.E. training to determine whether they had obtained knowledge that they could use for providing neonatal stabilization care. Participants were also asked whether the learned stabilization techniques had been incorporated into their clinical practice. A total of 64 surveys (54%) were completed and returned. More than 95% of the participants reported that the S.T.A.B.L.E. Program was "relevant and useful" in their practice. Ninety percent of the participants reported increased confidence in their stabilization skills, and 86.5% of the participants reported they had adopted the S.T.A.B.L.E. guidelines into their clinical practice.

During phase 2, a retrospective medical record review of 80 neonates transported between October 1998 and September 1999, a period prior to S.T.A.B.L.E. implementation, and 47 neonates transported between December 2000 and November 2001, following S.T.A.B.L.E. implementation, was undertaken. No statistical difference was found between the 2 groups for the physiologic parameters of temperature, blood glucose, and blood pressure. Several study limitations may partially explain this finding. First, the use of retrospective data precluded control over how and when data were collected or whether data were recorded. Second, a power analysis was not performed to determine the number of patients required for statistical comparison. Third, with regard to glucose values considered hypoglycemic, a lower glucose value of 36 mg/dL or 2 mmol/L was used; the S.T.A.B.L.E. Program recommends a target glucose value of 50 mg/dL or 2.8 mmol/L.[1] Had the higher number recommended by the S.T.A.B.L.E. Program been evaluated, there may have been differences between the 2 groups. Finally, a mean blood pressure equal to gestational age was accepted as normal in this study, whereas the S.T.A.B.L.E. guidelines use systolic, diastolic, and mean blood pressures related to birth weight and gestational age, values established by Versmold et al[11] to assess whether a blood pressure is normal or not.

Province of Manitoba

In Manitoba, provision of specialty education and training to scattered and isolated communities can be difficult and cost-prohibitive. Instructor shortages, high staff turnover, and the impact of long winters are additional challenges affecting outreach education. Videoconferencing has been used in Manitoba in an attempt to surmount these challenges. Researchers used a pretest/posttest control group study design to evaluate the effect of S.T.A.B.L.E. training delivered to 56 healthcare staff via either remote videoconferencing or in-person instruction.[12]

Test scores were compared for the control group, those receiving traditional, in-person S.T.A.B.L.E. training, with the intervention group, which received videoconferencing training. Both student cohorts demonstrated similar knowledge gains measured by pre- and posttesting. Posttraining student evaluations from both groups revealed satisfaction with the training received, whether in person or distance based. Those receiving S.T.A.B.L.E. training via videoconferencing sessions indicated they would be interested in future training delivery via this medium. Of concern, however, were the small sample sizes (30 videoconference and 26 face-to-face participants), thus limiting generalizability of the study findings.

S.T.A.B.L.E. PROGRAM CONTENT AND RELATIONSHIP TO REDUCING NEONATAL MORTALITY

The most recent matched birth and death statistics, compiled by the Centers for Disease Control and Prevention and the National Vital Statistics for the year 2008, provide insight as to the leading causes of neonatal mortality. In reviewing the 15 leading causes of neonatal mortality in the United States,[13] the reason for and the importance of the S.T.A.B.L.E. Program module content becomes evident. In 2007, 29 138 infants died in their first year of life. Of these infants, 19 058 died before completing 28 days of life.[14] All causes of neonatal mortality, except for the 14th cause of neonatal mortality—accidents,[13] are addressed in the S.T.A.B.L.E. Program in the form of risk factors, assessment, diagnosis, and/or management. Table 1 summarizes the leading causes of neonatal mortality and identifies the S.T.A.B.L.E. module that addresses those issues.

S.T.A.B.L.E. PROGRAM LEAD INSTRUCTOR SURVEY

In August 2011, a survey was sent to the 2263 registered S.T.A.B.L.E. lead instructors and 1253 surveys were completed for a total response rate of 55%. Tables 2 and 3 summarize the patient care departments and staff who are required to take S.T.A.B.L.E. as a condition of employment. Table 4 summarizes S.T.A.B.L.E. utilization by lead instructors. Complete survey results may be accessed online at the S.T.A.B.L.E. Program Web site[6].

Table 1. **The 15 leading causes of neonatal mortality, less than 28 completed days of life, in the United States in 2008[a]**

Cause of death	Percentage of total deaths in the neonatal period	S.T.A.B.L.E.[b] Program module(s) that address this issue
Disorders related to short gestation and low birth weight	25.4	S, T, A, B, L, E
Congenital malformations, deformations and chromosomal abnormalities	21.7	S, T, A
Newborn affected by maternal complications of pregnancy	9.6	S, T, A, B, L, E
Newborn affected by complications of placenta, cord, and membranes	5.9	S, B, L
Bacterial sepsis of newborn	3.7	B, L
Respiratory distress of newborn	3.4	A, B, L
Neonatal hemorrhage	3.0	B, L
Necrotizing enterocolitis of newborn	2.5	B, L
Intrauterine hypoxia and birth asphyxia	2.0	SA
Atelectasis	1.8	A
Sudden infant death syndrome	1.2	A, E
Pulmonary hemorrhage originating in the perinatal period	1.1	A, B, L
Hydrops fetalis not due to hemolytic disease	0.9	A, B
Accidents (unintentional injuries)	0.7	
Interstitial emphysema and related conditions originating in the perinatal period	0.7	A
All other causes	16.6	

[a]From the Centers for Disease Control and Prevention/National Center for Health Statistics, National Vital Statistics System[13]
[b]S, *S*ugar and *S*afe care; T, *T*emperature; A, *A*irway; B, *B*lood pressure; L, *L*ab work; E, *E*motional support.

Table 2. **Survey of 1253 S.T.A.B.L.E. lead instructors: Patient care departments that require S.T.A.B.L.E. as a condition of employment[a]**

Response	*n* (%)[b]
No staff in any departments are required to attend a S.T.A.B.L.E. course	312 (25.4)
Neonatal intensive care unit (new orientees plus all staff members)	516 (42.0)
Well baby nursery	418 (34)
Neonatal transport team	403 (32.8)
Special care nursery (includes intermediate care nursery)	353 (28.7)
Mother baby unit (postpartum)	325 (26.4)
Neonatal intensive care unit as part of initial orientation	318 (25.9)
Labor and delivery	304 (24.7)
Transition or observation nursery	277 (22.5)
Pediatric transport team	72 (5.9)
Perinatal special care unit (high-risk antenatal)	66 (5.4)
Emergency department	39 (3.2)
Other[c]	140 (11.4)

[a]From the S.T.A.B.L.E. Program.[6]
[b]Question answered by 1229 respondents; multiple choices allowed.
[c]Other department responses include respiratory care, family practice, family practice residency, life flight team, pediatric residency, perinatal transport, and high-risk obstetric transport team.

S.T.A.B.L.E. PSYCHOMETRICS AND TEST ANALYSIS

Since 1996, the S.T.A.B.L.E. Program has been serially updated, with the 6th edition targeted for publication

Table 3. **Survey of S.T.A.B.L.E. lead instructors: Disciplines that are required to attend S.T.A.B.L.E. training[a]**

Response	*n* (%)[b]
Registered nurse	863 (95.5)
Respiratory therapist	396 (43.8)
Neonatal nurse practitioner	231 (25.6)
Licensed practical nurse	137 (15.2)
Clinical nurse specialist	101 (11.2)
Pediatric resident	91 (10.1)
Neonatal fellow	60 (6.6)
Family practice resident	57 (6.3)
Paramedic	47 (5.2)
Emergency medical technician	36 (4)
Nurse midwife	31 (3.4)
Nursing assistant	29 (3.2)
Nurse anesthetist	10 (1.1)
Anesthesiology resident	10 (1.1)
Other[c]	62 (6.9)

[a]From the S.T.A.B.L.E. Program.[6]
[b]Question answered by 904 respondents; multiple choices allowed.
[c]Other disciplines include corpsmen, neonatologist, pediatrician, pediatric hospitalist, and nonspecific responses.

Table 4. **Survey of S.T.A.B.L.E. lead instructors: How S.T.A.B.L.E. is used**[a]

Response	*n* (%)[b]
Staff continuing education	980 (80.1)
Staff orientation	692 (56.5)
Outreach education	609 (49.8)
Transport team continuing education	375 (30.6)
Transport team orientation	332 (27.1)
Useful tool to help market our transport team and/or referral center	242 (19.8)
Residency training	180 (14.7)
Other[c]	52 (4.2)

[a]From the S.T.A.B.L.E. Program.[6]
[b]Question answered by 1224 respondents; multiple choices allowed.
[c]Other utilization includes referral hospital physicians, neonatal fellow orientation, certification review, medical students, and nonspecific responses.

in 2012. S.T.A.B.L.E. guidelines are written on the basis of the best evidence available at the time of each update. Expert content reviewers are also included in the review process to ensure quality and agreement that the guidelines are important elements of postresuscitation/pretransport stabilization care. The written examination completed by participants as part of S.T.A.B.L.E. training has also been rigorously examined with each update. S.T.A.B.L.E. learners complete a pretest before instruction and also a posttest after instruction is completed, with these scores compared to evaluate knowledge acquisition. In preparation for the S.T.A.B.L.E., 6th edition, questions from the current edition test were evaluated to determine answer responses and percentage of error rate by discipline (nursing, medicine, respiratory care, etc), as well as mean pre- and posttest scores by discipline. Pre- and posttest answer sheets were voluntarily returned from instructors throughout the United States and Canada. A total of 1476 matched pre- and posttests were evaluated; these tests were representative of S.T.A.B.L.E. participant demographics by discipline. Table 5 summarizes test scores by discipline.

Subanalysis of 25 pretest questions that generated an error rate of more than 30% were further critiqued by a panel of expert and experienced S.T.A.B.L.E. lead instructors. This analysis focused on the quality and clarity of each test item including question stems, distractors, and distractor error response rates. Four pretest questions (numbers 1, 14, 17, and 35) yielded an error rate of 10% or less and were therefore selected for review and were revised as appropriate. Table 6 summarizes the results of the high error rate questions by discipline. This important analysis provided an opportunity to inspect the incorrect distractor selections and evaluate these for poor function, ambiguity, and accuracy. Ideally, test takers should select distractors in equal proportions. When a distractor was found to have been selected disproportionately more than another distractor, the item was further analyzed and revised.

The next phase of test evaluation included distribution of revised pre and posttests to 35 lead instructors who volunteered to administer these tests during their S.T.A.B.L.E. courses. In addition, the program author also administered the revised test to all participants attending S.T.A.B.L.E. national instructor courses in 2010 and 2011. However, tests taken by national instructor attendees were not included in the student test analysis, but rather they served to establish the norm pretest score for high scorers. In phase 2 of this evaluation, 1132 matched pre- and posttests from 15 states were returned for analysis. Comparisons were made with validated testing benchmarks, which included an assessment of difficulty and discrimination indices for each question. For those questions considered out of range for difficulty and discrimination, inspection of the question stem and distractors was also performed.

The difficulty index is used as one marker of the quality of a test question. This index is commonly referred to as the *P* value and indicates the percentage of students answering the question correctly. The *P* value ranges from 0 to 1.0, and the range of desirable *P* values for a difficulty index is between 0.30 and 0.70.[15] In the revised test, no pretest question had a difficulty index below 0.6; 10 questions yielded a difficulty index between 0.6 and 0.7, 12 had a difficulty index between 0.71 and 0.79, 12 had a difficulty index between 0.8 and 0.89, and 6 had a difficulty index between 0.9 and 0.96. Although the difficulty indices did not reflect any pretest questions as significantly difficult, the scores did represent even distribution of difficulty on the 40-item test.

Several limitations of this study should be considered when interpreting these results. S.T.A.B.L.E. course participants are often asked to read the course manual before attending the course, which might explain some of the lower difficulty scores. In addition, students are frequently allowed to take the pretest before classroom presentation; therefore, there is no control over use of reference materials, including the S.T.A.B.L.E. course manual, or consultation with other healthcare professionals when answering questions. Finally, staff members were not classified by clinical area, specifically, those with or without NICU experience. Low difficulty scores on some of the questions may therefore be related to higher baseline knowledge possessed by some course participants.

Table 5. **S.T.A.B.L.E. pre- and posttest scores by discipline**

Discipline	Number ($n = 1476$)	% Students	Mean pretest score	Mean posttest score
Registered nurse	1254	85	73.1	94.6
Respiratory therapist	83	5.6	70.8	92.5
Physician	44	3.0	84	96.1
Licensed practical nurse	41	2.8	70.9	92.4

Reliable and psychometrically evaluated test questions add to the quality of the S.T.A.B.L.E. Program and enhance participant and employer satisfaction. Many course instructors compare pre- and posttest scores to evaluate both teaching effectiveness and attainment of learning. Hospital administrators may also request data on pre- and posttest scores to evaluate whether a program is both meaningful and cost-effective. This test evaluation sought to minimize the effect of low or high difficulty scoring because of poor test question construction. Therefore, when difficulty scores were out of range, the questions were further evaluated and revised as necessary. In addition, the answer sheets have been revised to allow learners to disclose their primary clinical area and will allow subanalysis of scores by workplace. Ongoing evaluation of the revised pre- and posttests is in progress, and a new revised test edition will be released with the 6th edition program materials.

S.T.A.B.L.E. 6th EDITION (2012) NEW CONTENT BY MODULE

As a result of emerging evidence in the stabilization and care of neonates, a revision to the S.T.A.B.L.E. Program is currently in process. The 6th edition, to be released in 2012, will contain updated information and guidance in several of the program modules. Highlights of these changes are summarized by module as follows.

Sugar and Safe care—"S"

In 2006, Rozance and Hay[16] evaluated the current evidence regarding neonatal hypoglycemia and concluded that there was inadequate information to define a level of hypoglycemia that would cause permanent central nervous system damage. Therefore, they recommended that practitioners define a blood glucose "target" that is appropriate to the neonatal population and commence treatment when values were below the selected target glucose value.[16] In 2008, a National Institute of Child Health and Human Development neonatal hypoglycemia working group identified numerous areas where knowledge and research gaps still exist, including the neurologic impact of symptomatic and asymptomatic hypoglycemia, what glucose level would be considered pathologic, and whether concurrent illnesses contribute to adverse outcomes when combined with low glucose values.[17]

Considering the ongoing controversy and uncertainty about what low glucose value may cause neurologic injury, the S.T.A.B.L.E. Program glucose management guidelines will remain the same in the 6th edition: for sick infants who cannot be fed enterally, plasma or whole-blood glucose values of less than 50 mg/dL (2.8 mmol/L) should be treated with an intravenous glucose infusion. In addition, care providers should repeat blood glucose testing until such time as 2 consecutive values of more than 50 mg/dL are obtained. This recommendation acknowledges the realities facing the less experienced neonatal care environment during stabilization of preterm or ill infants and provides guidance via a target treatment glucose value.

In support of the S.T.A.B.L.E. Program's conservative approach to glucose management of sick infants are the concerns raised as a result of magnetic resonance imaging and follow-up data in those neonates surviving hypoglycemic insult.[18–23] Although advances have been made in understanding the mechanisms related to altered neonatal glucose homeostasis, there remains much uncertainty regarding long-term consequences of hypoglycemia, including the levels at which injury actually occurs.[24] In addition, there is a research gap with regard to the impact of asymptomatic hypoglycemia and neurodevelopmental outcome.[17] Therefore, until more evidence is available, the S.T.A.B.L.E. Program recommends caution when using any guidelines that allow for persistence of low glucose values in apparently asymptomatic at-risk neonates (late preterm, large for gestational age, and infants of diabetic mothers).

Late preterm birth is defined as occurring between 34 0/7 and 36 6/7 weeks after the onset of the first day of the mother's last menstrual period.[25] Late preterm birth has emerged as a significant problem in the United States; in 2006, nearly 388 000 infants were born late preterm, accounting for approximately 71% of all preterm births and 9% of all live births.[26] Regardless of their weight, infants born before 37 weeks'

Table 6. **S.T.A.B.L.E. pretest questions with an error rate of 30% or more, by discipline**

Pretest, *n*	Registered nurse % with incorrect answer (*n* = 1,179)	Item response (% wrong answer chosen)	Respiratory therapist % with incorrect answer (*n* = 80)	Item response (% wrong answer chosen)	Physician % with incorrect answer (*n* = 44)	Item response (% wrong answer chosen)	Licensed practical nurse % with incorrect answer (*n* = 41)	Item response (% of wrong answer chosen)
2	43	B (61), C (37)	51	B (69) C (26)	18	B (75), C (25)	49	B (40), C (60)
3	18	B (79), C (20)	43	B (75) C (23)	9		27	B (73), C (27)
4	28	A (61), C (37)	31	A (58) C (31)	34	A (27), C (73)	27	A (55), C (45)
6	31	B (51), C (49)	31	B (54) C (46)	7		29	B (42), C (58)
8	21	A (22), B (76)	46	A (11) B (89)	5		24	A (20), B (80)
13	34	A (13), C (87)	34	A (14) C (82)	14		22	C (100)
15	50	B (77), C (20)	29	B (46) C (46)	52	B (96), C (4)	54	B (73), C (23)
16	44	A (82), B (18)	39	A (69) B (31)	14		39	A (75), B (25)
18	48	A (70), C (28)	25	A (62) C (33)	52	A (87), C (13)	41	A (59), C (41)
19	12		35	B (48) C (48)	7		22	B (78), C (22)
20	37	A (52), C (47)	60	A (58) C (36)	20	A (44), C (56)	46	A (42), C (58)
21	32	A (32), C (68)	27	A (27) C (68)	50	A (36), C (64)	34	A (29), C (71)
22	38	A (12), B (87)	36	A (40) B (60)	30	A (8), B (92)	39	A (50), B (50)
23	31	B (64), C (30)	6		11		27	B (64), C (36)
25	30	A (41), B (50)	6		5		17	
26	41	B (35), C (58)	22	B (22) C (78)	16		34	B (21), C (79)
27	9		41	A (44) B (56)	0		20	A (50), B (50)
29	28	A (44), C (53)	30	A (32) C (64)	20	A (11), C (89)	24	A (90), C (10)
30	40	A (35), C (64)	52	A (37) C (63)	36	A (19), C (81)	51	A (33), C (62)
31	40	B (43), C (54)	42	B (31) C (66)	23	B (50), C (50)	49	B (30), C (70)
32	27	A (41), C (54)	33	A (30) C (59)	5		39	A (13), C (75)
34	22	A (43), B (55)	25	A (57) B (43)	16		41	A (53), B (35)
36	33	A (14), B (84)	59	A (8) B (90)	9		51	A (5), B (90)
38	47	A (3), C (95)	46	A (3) C (97)	16		51	A (5), C (95)
39	36	A (39), B (59)	36	A (43) B (57)	41	A (50), B (50)	24	A (40), B (60)

gestation are metabolically and physiologically immature. The earlier the gestation, the more pronounced this becomes. The 6th edition Sugar and Safe care module will include information pertaining to the clinical complications most commonly encountered when an infant is born late preterm: respiratory difficulties, temperature instability, hypoglycemia, unconjugated hyperbilirubinemia, apnea, and feeding problems.[25]

In addition, late preterm infants have a higher mortality rate, with Tomashek and colleagues.[27] reporting a 3-fold higher rate of infant mortality among these infants than among term infants, a disparity that is greatest in the first week after birth. Late preterm infants surviving into childhood are also thought to be at increased risk for adverse neurodevelopmental and behavioral complications.[26]

Temperature—"T"

Neuroprotective hypothermia

For the vast majority of babies, maintenance of a normal body temperature and prevention of hypothermia is a top priority. However, for a small percentage of neonates who experience hypoxic-ischemic encephalopathy (HIE), intentional, neuroprotective hypothermia is the new standard of care. Lowered body temperature, as a treatment of HIE, has been studied extensively over the past 4 decades. Such inquiry has ranged from early attempts to define the etiology of HIE and predict the clinical and neurodevelopmental presentation of sequelae to current research aimed at understanding HIE pathogenesis in terms of damage to brain tissue. Although encephalopathy may proceed from multiple causes and encompass alterations in brain structure or function, the hypoxia and ischemia associated with HIE result from a specific path to injury. Hypothermal treatment has been found to be therapeutic, interrupting the cascading series of events that contribute to and promote parenchymal brain injury.[28]

Therapeutic hypothermia, administered via head or whole-body cooling, confers neuroprotection during a narrow time-delineated window following initial hypoxic-ischemic insult. To achieve maximal efficacy, cooling treatment must be started during this treatment time frame and prior to progression to the neuronal loss that is associated with secondary injury. Candidates for therapy include term infants older than 36 completed weeks of gestation and weighing more than 1800 g, and cooling must be initiated prior to 6 hours of age. Clinical data used in arriving at a decision to initiate cooling include blood gas pH and base deficit, low Apgar scores, perinatal events such as abruption or uterine rupture, or the presence of encephalopathic seizures.[29]

Hypoxic-ischemic encephalopathy affects between 2 and 3 term infants per 1000 live births, suggesting a potential target cohort of 8000 to 12000 infants per year in the United States. For every 6 to 9 affected infants receiving hypothermic therapy, one fewer infant dies or suffers significant neurodevelopmental disability.[28] Therapeutic hypothermia cannot be viewed as a cure for HIE, but its judicious and timely application can improve outcomes for the population of affected infants. The 6th edition Temperature module will include information regarding therapeutic hypothermia, including candidacy and criteria for cooling, and recommendation that referral for cooling be initiated expeditiously to initiate therapy within 6 hours of birth.

Airway—"A"

Laryngeal mask airway

Endotracheal intubation may be a challenging procedure especially when there is little opportunity to practice this advanced life support skill. Three recent studies have shed light on concerns regarding intubation proficiency in neonatal care. In Canada, Bismilla et al[30] described the success rate of intubations as defined by Neonatal Resuscitation Program criteria and found that success rates were low and not within Neonatal Resuscitation Program time frame standards. These findings confirm earlier study results, which revealed similar problems in healthcare provider acquisition and maintenance of intubation skills.[31,32]

Laryngeal mask airway (LMA) is a device that fits over the laryngeal inlet and has been demonstrated to be effective in ventilating newborns weighing more than 2000 g or delivered on or after 34 weeks' gestation.[33] Several studies[34,35] demonstrate that a seal may be achieved and oxygenation restored within very narrow time frames, even in babies weighing 1 to 1.5 kg. The 6th edition Neonatal Resuscitation Program provides education regarding proper LMA placement as a strategy to secure and maintain a patent airway in those circumstances in which intubation is difficult or an intubation-skilled provider is unavailable.[36] In support of all providers of postresuscitation/pretransport stabilization, the S.T.A.B.L.E. Program 6th edition will provide additional instruction regarding the correct use of the LMA as a potential airway-securement procedure.

Predischarge pulse oximetry screening for cyanotic congenital heart disease

CHD is the most common congenital defect. It carries a high morbidity and mortality during the first month and year of life, especially when not discovered and treated promptly. Early diagnosis and treatment, including surgical repair, have improved neonatal and pediatric outcomes. Currently, clinicians rely on antenatal ultrasound screening and the predischarge physical examination to identify at-risk infants. However, studies suggest that up to 50% of CHD in newborns is missed because of reliance on these strategies alone.[37]

Although effective treatment is available once CHD is diagnosed, a robust screening tool—one that is technology driven, sensitive, simple to use, and cost-effective—has remained underutilized. Pulse oximetry has been considered an effective tool for such a task, given its characteristics as a noninvasive and easily administered screening strategy and one that is already available and accepted in the in-patient setting. As a result, there have been increasing calls for pulse oximetry to be included as a routine component of predischarge newborn physical examination.[38] However, concerns have also been raised as to the reliability of the adoption of a pulse oximetry strategy and have included questions as to test sensitivity, test false positives, costs of screening, and proficiency of screening personnel.[39] In answering concerns regarding diagnostic reliability of pulse oximetry, advocates acknowledge that pulse oximetry cannot screen for all CHDs.[40] Information explaining predischarge pulse oximetry screening for CHD will be included in the 6th edition update.

Blood pressure—"B"

Dopamine

The S.T.A.B.L.E. Blood Pressure module includes dopamine dosing and step-by-step instructions in mixing dopamine in the event a pharmacist is not available to provide this service. The final concentration of 800 μg/mL recommended in S.T.A.B.L.E. is less concentrated than the strengths used in the tertiary NICU environment; therefore, it is intended for use by less experienced neonatal caregivers. A dopamine concentration of 800 μg/mL offers 2 primary benefits. First, should this powerful medication be administered unintentionally via a bolus, or as a larger dose than intended, the negative impact on the infant's cardiovascular state may be attenuated. Second, when dopamine is mixed in D10W (dextrose 10% in water), as recommended by S.T.A.B.L.E., the final dilution allows for short-term administration of dopamine at a rate that will also support glucose administration, especially when given in accordance with the recommended infusion of D10W at a rate to provide 80 mL/kg per day.

Recently, a meta-analysis evaluating dopamine use and premature infants reported that dopamine administration was effective in enhancing cerebral blood flow. Furthermore, this analysis suggested that dopamine improves cerebral blood flow in hypotensive preterm infants to a greater extent than similar administration in normotensive preterm infants. Dopamine more effectively improves cerebral blood flow than individual use of dobutamine, hydrocortisone, or colloids.[41] Recent evidence supports ongoing inclusion of dopamine in the S.T.A.B.L.E. curriculum as pressor therapy for hypotensive neonates.

SUMMARY

Since 1996, the S.T.A.B.L.E. Program has provided evidence-based education in the postresuscitation stabilization of sick newborns to more than a quarter million perinatal healthcare team members from around the world. The program, aimed at preventing the leading causes of neonatal mortality, continues to be the subject of published peer-reviewed research and is periodically updated to ensure relevancy and inclusion of current best evidence. S.T.A.B.L.E. is a mnemonic for the 6 essential assessment parameters taught in the program: *S*ugar and *S*afe care, *T*emperature, *A*irway, *B*lood pressure, *L*ab work, and *E*motional support. This mnemonic was specifically chosen to serve as a memory tool to remind staff of "what to do" during those infrequent but stressful times when they were expected to assess and stabilize sick newborns. The S.T.A.B.L.E. credential is obtained as a result of didactic training and successful completion of content testing; testing quality is ensured through ongoing validation via psychometric analysis. The 6th edition of S.T.A.B.L.E. is scheduled for release in 2012 and will reflect the latest in stabilization guidelines throughout the program's 6 modules.

References

1. Karlsen KA. *The S.T.A.B.L.E. Program: Pre-Transport/Post-Resuscitation Stabilization Care of Sick Infants: Guidelines for Neonatal Healthcare Providers*. 5th ed. Salt Lake City, UT: S.T.A.B.L.E. Inc; 2006.
2. Karlsen KA. *S.T.A.B.L.E. Cardiac Module: Recognition and Stabilization of Neonates With Severe CHD*. Salt Lake City, UT: S.T.A.B.L.E. Inc; 2003.
3. Karlsen KA. *The S.T.A.B.L.E. Program: Physical Exam/Gestational Age Assessment Slide Set (CD-ROM)*. Salt Lake City, UT: S.T.A.B.L.E. Inc; 2006.
4. Karlsen KA. *Neonatal Stabilization Scenarios*. Salt Lake City, UT: S.T.A.B.L.E. Inc; 2012.
5. The S.T.A.B.L.E. Program. S.T.A.B.L.E. learner course student statistics. http://www.stableprogram.org/statistics.php. Accessed January 15, 2012.
6. The S.T.A.B.L.E. Program. S.T.A.B.L.E. lead instructor survey. http://www.stableprogram.org/downloads/SURVEY_Summary.pdf. Accessed March 28, 2012.
7. Diehl-Svrjcek BC, Price-Douglas W, Flagg J. Neonatal glucose testing via prompted intervention during the pretransport phase of care. *Adv Neonatal Care*. 2011;11(5):340–348.
8. Veronica RM, Gallo LL, Medina DR, et al. Safe neonatal transport in the state of Jalisco: impact of the S.T.A.B.L.E. program on morbidity and mortality. *Bol Med Hosp Infant Mex*. 2011;68(1):31–35.

9. Spector JM, Villanueva HS, Brito ME, Sosa PG. Improving outcomes of transported newborns in Panama: impact of a nationwide neonatal provider education program. *J Perinatol*. 2009;29(7):512–516.
10. O'Neill N, Howlett AA. Evaluation of the impact of the S.T.A.B.L.E. Program on the pretransport care of the neonate. *Neonatal Netw*. 2007;26(3):153–159.
11. Versmold HT, Kitterman JA, Phibbs RH, Gregory GA, Tooley WH. Aortic blood pressure during the first 12 hours of life in infants with birth weight 610 to 4,220 grams. *Pediatrics*. 1981;67(5):607–613.
12. Loewen L, Seshia MM, Askin DF, Cronin C, Roberts S. Effective delivery of neonatal stabilization education using videoconferencing in Manitoba. *J Telemed Telecare*. 2003;9(6):334–338.
13. Centers for Disease Control and Prevention. *Infant, Neonatal, and Postneonatal Deaths, Percent of Total Deaths, and Mortality Rates for the 15 Leading Causes in Infant Death by Race and Sex: United States 2008*. Atlanta, GA: CDC/NCHS, National Vital Statistics System; 2008:8. http://www.cdc.gov/nchs/data/dvs/LCWK7_2008.pdf. Updated December 14, 2011. Accessed March 28, 2012.
14. Centers for Disease Control and Prevention. Infant mortality statistics from the 2007 period linked birth/infant death data set. *Natl Vital Stat Rep*. 2011;59(6)1–31. http://www.cdc.gov/nchs/data/nvsr/nvsr59/nvsr59_06.pdf. Updated June 29, 2011. Accessed March 28, 2012.
15. Oermann MH, Gaberson KB. *Evaluation and Testing in Nursing Education*. 3rd ed. New York, NY: Springer Publishing Co; 2009.
16. Rozance P, Hay W. Hypoglycemia in newborn infants: features associated with adverse outcomes. *Biol Neonate*. 2006;90:74–86.
17. Hay W, Raju T, Higgins R, Kalhan S, Devaskar S. Knowledge gaps and research needs for understanding and treating neonatal hypoglycemia: workshop report from Eunice Kennedy Shriver National Institute of Child Health and Human Development. *J Pediatr*. 2009;155(5):612–617.
18. Burns CM, Rutherford MA, Boardman JP, Cowan FM. Patterns of cerebral injury and neurodevelopmental outcomes after symptomatic neonatal hypoglycemia. *Pediatrics*. 2008;122(1):65–74.
19. Caraballo RH, Sakr D, Mozzi M, et al. Symptomatic occipital lobe epilepsy following neonatal hypoglycemia. *Pediatr Neurol*. 2004;31(1):24–29.
20. Filan PM, Inder TE, Cameron FJ, Kean MJ, Hunt RW. Neonatal hypoglycemia and occipital cerebral injury. *J Pediatr*. 2006;148(4):552–555.
21. Karimzadeh P, Tabarestani S, Ghofrani M. Hypoglycemia-occipital syndrome: a specific neurologic syndrome following neonatal hypoglycemia? *J Child Neurol*. 2011;26(2):152–159.
22. Kinnala A, Rikalainen H, Lapinleimu H, Parkkola R, Kormano M, Kero P. Cerebral magnetic resonance imaging and ultrasonography findings after neonatal hypoglycemia. *Pediatrics*. 1999;103(4, pt 1):724–729.
23. Per H, Kumandas S, Coskun A, Gümüs H, Oztop D. Neurologic sequelae of neonatal hypoglycemia in Kayseri, Turkey. *J Child Neurol*. 2008;23(12):1406–1412.
24. McGowan JE. Neonatal hypoglycemia: fifty years later, the questions remain the same. *NeoReviews*. 2004;5(9):e363–e364. doi:10.1542/neo.5-9-e363.
25. Engle WA. Infants born late preterm: definition, physiologic and metabolic immaturity, and outcomes. *NeoReviews*. 2009;10(6):e280–e286. doi:10.1542/neo.10-6-e280.
26. Shapiro-Mendoza CK. Infants born late preterm: Epidemiology, trends, and morbidity risk. *NeoReviews*. 2009;10(6):e287-e294. doi:10.1542/neo.10-6-e287.
27. Tomashek KM, Shapiro-Mendoza CK, Davidoff MJ, Petrini JR. Differences in mortality between late-preterm and term singleton infants in the United States, 1995–2002. *J Pediatr*. 2007;151(5):450–456.
28. Laptook AR. Use of therapeutic hypothermia for term infants with hypoxic-ischemic encephalopathy. *Pediatr Clin North Am*. 2009;56:601–616.
29. Wachtel EV, Hendricks-Munoz KD. Current management of the infant who presents with neonatal encephalopathy. *Curr Probl Pediatr Adolesc Health Care*. 2011;41:132–153.
30. Bismilla Z, Finan E, McNamara PJ, LeBlanc V, Jefferies A, Whyte H. Failure of pediatric and neonatal trainees to meet Canadian Neonatal Resuscitation Program standards for neonatal intubation. *J Perinatol*. 2010;30(3):182–187.
31. O'Donnell CP, Kamlin CO, Davis PG, Morley CJ. Endotracheal intubation attempts during neonatal resuscitation: success rates, duration, and adverse effects. *Pediatrics*. 2006;117(1):e16–e21.
32. Falck AJ, Escobedo MB, Baillargeon JG, Villard LG, Gunkel JH. Proficiency of pediatric residents in performing neonatal endotracheal intubation. *Pediatrics*. 2003;112(6-1):1242–1247.
33. Kattwinkel J, Perlman JM, Aziz K, et al. Part 15: Neonatal resuscitation: 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2010;122:S909–S919.
34. Paterson SJ, Byrne PJ, Molesky MG, Seal RF, Finucane BT. Neonatal resuscitation using the laryngeal mask airway. *Anesthesiology*. 1994;80(6):1248–1253.
35. Gandini D, Brimacombe JR. Neonatal resuscitation with the laryngeal mask airway in normal and low-birth-weight infants. *Anesth Analg*. 1999;89(3):642–643.
36. Kattwinkel J, McGowan JE, Zaichkin J.. Textbook of Neonatal Resuscitation. 6th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2011.
37. Ewer AK, Middleton LJ, Furmston AT,et al; on behalf of the Pulse Ox Study Group. Pulse oximetry screening for congenital heart defects in newborn infants (PulseOx): a test accuracy study. *Lancet*. 2011;378:785–794.
38. Meberg A, Brugmann-Pieper S, Due R Jr, et al. First day of life pulse oximetry screening to detect congenital heart defects. *J Pediatr*. 2008;152:761–765.
39. Walsh W. Evaluation of pulse oximetry screening in Middle Tennessee: cases for consideration before universal screening. *J Perinatol*. 2011;31:125–129.
40. Arlettaz R, Bauschatz AS, Monkhoff M, Essers B, Bauersfeld U. The contribution of pulse oximetry to the early detection of congenital heart disease in newborns. *Eur J Pediatr*. 2006;165:94–98.
41. Sassano-Higgins S, Friedlich P, Seri I. A meta-analysis of dopamine use in hypotensive preterm infants: blood pressure and cerebral hemodynamics. *J Perinatol*. 2011;31(10):647–655.