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A Standardized Approach to the Care of the Infant Born at the Threshold of Viability

By Carl Backes, Jr., MD; Elizabeth M. Martin, MSN, RNC and Leif D. Nelin, MD

Introduction

Infants born prematurely at the threshold of viability (22 to 26 weeks gestational age) continue to present complex and unique medical, social and ethical problems. Preterm birth is defined as delivery occurring before 37 completed weeks of gestation and currently represents about 13% of all live births in the United States.[1] The rate of all preterm birth in the United States is increasing, as is the number of preterm infants born at the threshold of viability. Preterm infants designated as "extremely" low gestational age (ELGA), typically born at <1000 grams, represent only 0.7% of all premature deliveries.[2] Despite their small numbers, these patients account for a substantial portion of perinatal mortality and morbidity.[3] With advances in perinatal care, the survival of ELGA increased from the 1980's to 2000.[4] However, recent evidence suggests that over the last decade there has been little subsequent improvement in the survival rates for this patient population, particularly those born weighing less than 750 grams.[5, 6] It should be kept in mind that survival numbers pertain to a population, and these numbers indicate that there is a great deal of uncertainty in predicting either the survival or the eventual outcome of any given baby. Therefore, the care of any given baby born at the threshold of viability must be tailored to meet the needs of the baby, the family, the health-care team, and society.[7] It is imperative then that the health-care professionals involved in the care of these highly vulnerable infants are aware of the data, both published and local, in order to consider the chances of each baby while engaging in a meaningful relationship with the family.

"Infants born prematurely at the threshold of viability (22 to 26 weeks gestational age) continue to present complex and unique medical, social and ethical problems."

Inconsistency in the clinical approach, both within and across institutions, as well as the highly variable attitudes of healthcare providers toward infants born at the threshold of viability likely contributes to recent survival trends.[8] Adult and pediatric studies have consistently shown that the implementation of structured, evidence-based guidelines results in improved patient outcomes. For instance, the use of practice guidelines in the care of adult patients with stroke and congestive heart failure has been shown to improve survival and decrease morbidity rates.[9,10] In pediatrics, the use of guidelines in the care of patients with asthma has decreased short and long-term morbidities, decreased hospitalizations for asthma related complications, and improved survival.[11,12] On the other hand, there is little solid evidence on which to formulate standardized guidelines for ELGA infants. This uncertainty has led to highly variable practice patterns between healthcare providers and likely contributes to worse clinical outcomes.[13] Thus, we identified that a reason-

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able, unified, inter-disciplinary approach to the family-centered care of these infants was needed. In order to address this critical need, a multidisciplinary committee (the Small Baby Committee) consisting of physicians, neonatal nurse practitioners, nurses, respiratory therapists, nutritionists, pharmacists, occupational and physical therapists was formed to develop guidelines to cover the routine, daily care of the <27 week infant. Although we took the approach that creating these guidelines (Small Baby Guidelines or SBG) based on available evidence would be a priority, we realized that for many of our neonatal care practices there is a lack of quality evidence to make strong recommendations. Thus, our primary goal was to eliminate as much inconsistency and variability in practice pattern as possible in the care of this very vulnerable population.

General Implementation of Small Baby Guidelines (SBG) at our Institution

The NICU at Nationwide Children's Hospital (NCH) is an all-referral Level 3C Unit. There are over 40 neonatologists divided between three practice groups, as well as over 150 nurses, 25 respiratory therapists, and a large number of ancillary neonatal professionals including nutritionists, OT, PT, social workers, discharge planners, pharmacists, etc. that provide the daily care for the infants in the NICU. Given the large number of healthcare workers, it was clear that the clinical approach for infants at the threshold of viability (22–26 weeks) was inconsistent, often leading to variable, and sometimes contradictory, messages to parents and families. Given that a recent study showed that the incidence of intraventricular hemorrhage (IVH) can be reduced by developing a standardized approach to the care of ELGA infants, we felt that more unified agreement in care practices at out institution would translate into improved outcomes for these ELGA patients.[14] We began by developing a set of SBG that covered the 22–26 weeker admitted during the critical first week of life (SBG I). Once the SBG I were fully implemented we developed guidelines for the care of these ELGA infants during the 2nd to 4th weeks of life (SBG II). Once SBG II was fully implemented we developed guidelines for the care of <27 weekers from day of life 29 to discharge from the NICU (SBG III). The entire implementation of all 3 SBG took about 5 years. We would like to emphasis that the optimal management strategies for many of the complications of preterm infants remains unknown.[2] Here, we discuss our management strategy, as outlined in the SBG, to reduce the morbidity associated with three commonly seen complications of ELGA infants: bronchopulmonary dysplasia (BPD), intraventricular hemorrhage (IVH), and necrotizing enterocolitis (NEC). Since these complications are strongly associated with later neurodevelopmental disability and mortality, we felt that implementation of the SBG should decrease their number and severity and positively impact survival rates. Indeed, we designed data collection and review as an integral part of the SBG, such that if outcomes were not improved, or if portions of the guidelines provided to be impractical or impossible to implement, the guidelines could be revised. In what follows regarding our SBG, we provide what evidence is available to support our current management. We will emphasis again though that in the absence of evidence, decreasing variability and inconsistency remains a primary purpose of these guidelines. Thus, for the time being until new evidence becomes available, the primary purpose for the majority of these guidelines is to decrease variability and thereby increase safety and quality of care for the infant born at the threshold of viability.

"...we discuss our management strategy, as outlined in the SBG, to reduce the morbidity associated with three commonly seen complications of ELGA infants: bronchopulmonary dysplasia (BPD), intraventricular hemorrhage (IVH), and necrotizing enterocolitis (NEC)."

Evaluation of the Impact of SBG's on Neonatal Outcomes

In an effort to evaluate the potential impact of the SBG's on morbidity and mortality, we compared neonatal outcomes (BPD, IVH, NEC) and survival rates of infants born <27 weeks before and after implementation of the SBG I. To that end, we retrospectively collected data on infants <27 weeks that were admitted to our NICU between November 1st , 2003 and October 31st, 2004 prior to the SBG I (comparison) and compared that to data gathered prospectively on all infants <27 weeks cared for under SBGI from November 1st, 2004 to October 31st, 2005 (SBG I).

Strategies in SBG's to Potentially Reduce the Incidence of BPD

Bronchopulmonary dysplasia (BPD) is a main cause of chronic respiratory illness in ELBW infants.[15] Neonates with birthweights <1250 grams account for 97% of the cases of BPD.[16] The disorder is defined as a supplemental oxygen requirement at 28 days of age and then classified as mild, moderate, or severe depending on the level of oxygen requirement at 36 weeks post-conceptual age.[17] The pathogenesis of BPD is complex and multifactorial, with the prevention of preterm birth the only definitive intervention shown to decrease the incidence of the disorder.[18] Given the lack of data to support the superiority of one ventilator strategy over another, the guidelines strongly suggested limiting mechanical ventilation to as short a time as feasible. SBG I strongly suggested extubation to nasal constant positive airway pressure (nCPAP) within the first 7 days of life.

There is evidence in the form of a multi-center trial of over 2,000 preterm infants that reported that caffeine decreases the incidence of BPD as defined by supplemental oxygen requirement at 36 weeks post-conceptual age.[19] The authors suggest that the beneficial effect of caffeine on BPD rates likely is due to shorter exposure to mechanical ventilation in the caffeine group. In addition, caffeine was also shown in this study group to decrease the combined end-point of death or survival with neurodevelopmental disability, as well as reducing the incidence of cerebral palsy.[20] Thus, based on these data the SBG calls for caffeine administration to begin on admission to the NICU. Given that most neonatal respirators employ patient-triggered ventilation increasing a patient's respiratory drive may be beneficial even during mechanical ventilation.

In general, studies have shown that premature infants need careful fluid restriction to meet physiological needs without causing dehydration.[21] Excessive intravenous fluid administration has been shown to increase the risk for a number of significant morbidities, including BPD.[22] Judicious fluid restriction can be achieved by avoiding insensible water losses through maintenance in a high humidity environment.[23, 24] We advocate 80% humidity in the first 3 days of life and then 60% humidity from days 4-14.[25] We found greatly increased adherence to appropriate humidity levels following implementation of SBG. With strict nursing policies to maintain these humidity levels, our total fluid goal on admission in the first week of life is between 100-120 ml/kg/day.

Supplementation with Vitamin A has also been found to reduce the need for oxygen use among survivors at 36 weeks corrected gestational age and the combined endpoint of death or oxygen requirement at 28 days in ELBW patients.[26] Although the mechanisms for the beneficial effects of Vitamin A have not been fully elucidated, improved lung healing, reduced susceptibility to infection, and increased alveolar number may contribute.[27] Importantly, no studies to date have shown clinical or biochemical evidence of Vitamin A toxicity following supplementation. Thus, our current guideline is that any patient who is admitted at

<96 hours of age and was born at <1001 grams receives 5,000 IU of Vitamin A three times a week for a total of 12 doses.

Following the implementation of the SBG I emphasizing the use of caffeine, vitamin A, and judicious fluid restriction in the first week of life, we found a trend (p = 0.054) toward a decrease in days on mechanical ventilation and discharge on oxygen (p = 0.076). Importantly, although the incidence of overall BPD was not different between the two groups, there was a significant reduction in the incidence of BPD among ELGA survivors following implementation of the SBG I compared to the comparison group (Figure 1). We recognize that the incidence of BPD in this population appears relatively high, however our population only includes those infants born at <27 weeks gestational age and about one-third of our infants were born between 22-24 weeks gestational age.

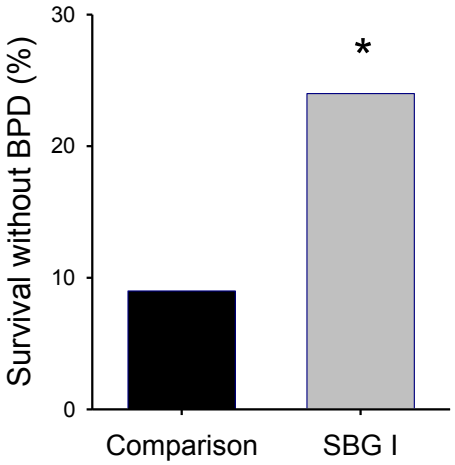

*Figure 1. Rate of combined end-point survival without BPD. * SBG I different from comparison, p<0.05.*

Neurodevelopment

Intraventricular hemorrhage (IVH) is an important cause of brain injury in the preterm infant and IVH is associated with significant short and long-term morbidities.[28] Long-term neurocognitive outcomes are influenced by the severity of IVH (Grades 1–4), with the most severe hemorrhages increasing the risk for impairments.[29] The risk for IVH is inversely related to gestational age and weight, with estimates of the incidence of severe IVH (Grade 3 or 4) in ELGA between 10-46%.[30] We assessed IVH by head ultrasound read and graded by radiology and used the head ultrasound with the most severe IVH. Below, we discuss strategies in the SBG to decrease the incidence of IVH in our ELGA infants.

A recent meta-analysis showed that prophylactic indomethacin reduces the incidence of symptomatic patent ductus arteriosus (PDA), PDA ligation, and the rate of severe IVH (Grade 3 and 4).[31] The meta-analysis found no evidence of an effect on mortality or on the composite outcome of death or severe neurodevelopmental outcome.[31] However, given the current uncertainty of how to approach the PDA in the ELGA patient, and the suggestion that PDA ligation may increase the incidence of BPD and adverse neurodevelopmental outcomes,[32,33] and considering that prophylactic indomethacin is relatively well-tolerated in this population, we have included prophylactic indomethacin therapy in the SBG and we give indomethacin 0.1mg/kg every 24 hours for the first 3 days of life.

Unrecognized or inadequately treated pain in the neonatal population increases the risk for adverse short and long-term neurodevelopmental outcomes.[34] To that end, evidence suggests that infants in the NICU are exposed to 10-15 painful procedures per day, and that most of the painful procedures are not treated.[35] On the other hand, the routine use of opiates in the NICU has unwanted effects on important developmental trajectories.[36] More recent evidence suggests that the selective use of opiates for procedural and chronic pain is most efficacious.[37] The SBG include guidelines for routine pain control and post-procedural pain. Indeed, the SBG state that the most effective way of reducing minor procedural pain is to reduce the number of procedures performed, including limiting cares to every 6 hours, decreasing blood draws, and suctioning only when clinically indicated. In addition, the SBG emphasize the importance of non-pharmacological measures for pain prevention, including the use of oral sucrose, non-nutritive sucking, swaddling, and kangaroo care.[38,39]

The overall incidence of IVH (Grade I through IV) was not different before or after implementation of SBG I. However, there was a significant increase in survival without severe IVH (Grade 3 or 4) following the implementation of the SBG I (Figure 2). The neurodevelopmental outcomes at 18 months were better in the SBG I group than in the comparison group. In 20 patients from the comparison group and 22 patients from SBG I data who had 18 month Bayley exam data available, (the mean age for the comparison group was 20.0 ± 2.5 months and for the SBG I group 18.2 ± 4.4 months), as expected the comparison group had more (p = 0.02) IVH (76%) than did the SBG I group (48%). The Bayley results for MDI and PDI are shown in Figure 3 and demonstrate a significantly better score in the SBG I patients than in the comparison patients.

Necrotizing Enterocolitis

Necrotizing enterocolitis (NEC) is the most common gastrointestinal emergency in the preterm infant.[40] The incidence of NEC is inversely related to gestational age and has been shown to account for 15% of all deaths

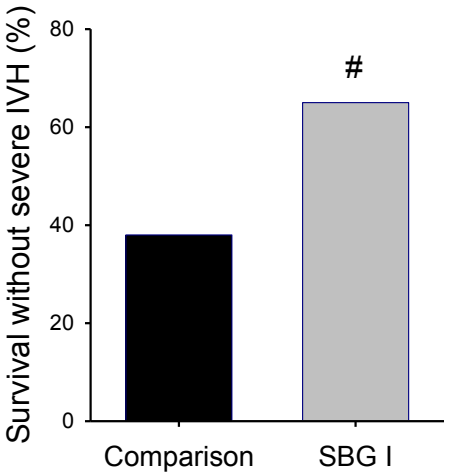

Figure 2. Rate of combined end-point survival without severe IVH. # SBGI different from comparison, p<0.01.

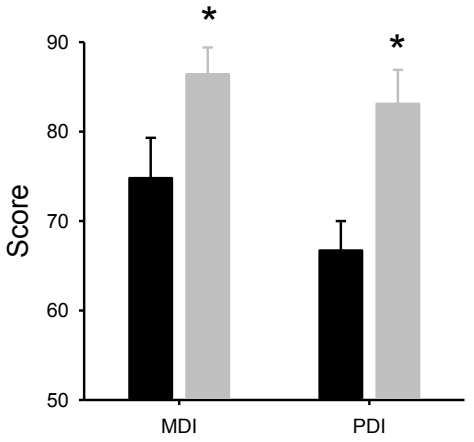

*Figure 3. Eighteen month Bayley MDI and PDI scores for comparison (black bars) and SBG I (grey bars) groups. * SBG I different from comparison, p<0.05.*

after the first week of life for infants weighing 1500 grams or less at birth.[41] Despite concerted efforts to recognize the disorder early in its progression, NEC accounts for substantial long-term morbidities and mortality in preterm infants, particularly in ELGA populations.[42] Necrotizing enterocolitis (NEC) was diagnosed clinically and radiographically using Bell's criteria.[43,44]

Feeding mom's own breast milk to her baby has consistently been shown to reduce the incidence of NEC.[45] Indeed, it has been shown that extremely premature infants who are fed their mother's own breast milk during their NICU stay have improved neurodevelopmental outcomes at 18 months of age, an improvement that persists at 30 months of age.[46,47] In addition, there is evidence showing that providing small quantities of human milk instead of only total parental nutrition (TPN) decrease the time to achieve full enteral feeds and length of hospitalization, without increasing the risk for

Table 1			
FEEDING – DOL	VOLUME (mL/Kg/d)	MODE	PHASE
3	10	Bolus	Trophic
4	10	Bolus	Trophic
5	10	Bolus	Trophic
6	10	Bolus	Trophic
7	10	Bolus	Trophic
8	10	Bolus	Trophic
9	10	Bolus	Trophic
10	10	Bolus	Trophic
11	15	Bolus	Transition
12	15	Bolus	Transition
13	15	Bolus	Transition
14	20	Bolus	Transition
15	40	Bolus	Advancement
16	60	Bolus	Advancement
17	80	Bolus	Advancement
18	100[t]	Bolus	Advancement
19	120	Bolus	Advancement
20	140	Bolus	Advancement
21	150[tt]	Bolus	Advancement
†start human milk fortification using 1 packet per 50 ml milk ††increase fortification to 2 packets per 50 ml milk			

NEC.[48,49] In the SBG, enteral feedings with unfortified human milk are started in the first days after birth, and no later than day of life 3, to prime the premature gastrointestinal tract unless there exists a contraindication to using the GI tract. The SBG strongly advocate using mom's own breast milk for feedings these infants. In cases where mom's own milk is unavailable then the SBG suggests utilizing donor breast milk.[50] Furthermore, the SBG strongly supports using mom's own milk throughout the hospitalization. Fortification is added to the breast milk to provide necessary proteins, vitamins and calories to these growing ELGA infants. Thus, early trophic feeds, mom's own milk and judicious advancement are key to safe feeding of the ELGA infant, Table 1 is the SBG feeding advancement algorithm.[51,52]

This table is used in conjunction with our feeding intolerance algorithm to determine when feeds are advanced, held or stopped. Our feeding intolerance algorithm defines feeding intolerance, when feeding intolerance is present the physical exam is the first break-point. If the physical exam is abnormal, then an abdominal X-ray is the next break-point, and if an abnormal laboratory work-up and treatment would depend on the X-ray findings.[51,52] Although our numbers are small, the incidence of NEC following implementation of the SBG I tended to be lower than in the comparison group (Figure 4). Our incidence of NEC is also relatively high in this ELGA population, but our NICU is the only NICU with pediatric surgery and thus services all level 2 and 3 NICUs in Central Ohio.

Overall Survival Data

Given the incremental implementation of our SBG I, II and III, there were ELGA patients admitted prior to the implementation of SBG III that were not eligible for the on-going SBG in the NICU at the time of admission. We compared outcomes of those <27 weekers admitted who were cared for using the SBG and those <27 weekers who were not eligible for the SBG at time of admission (i.e. admitted after day of life 7 prior to implementation of SBG II). There were 98 <27 week infants admitted during either SBG I or II that did not qualify for the on-going SBG, and 189 admitted that were cared for using the SBG. The mean gestational age was 24.8 ± 1.1 and 24.7 ± 1.1 weeks gestation, respectively. The data showed an improvement in survival in those infants cared for using the SBG (83% for the SBG patients versus 72%, p<0.05).

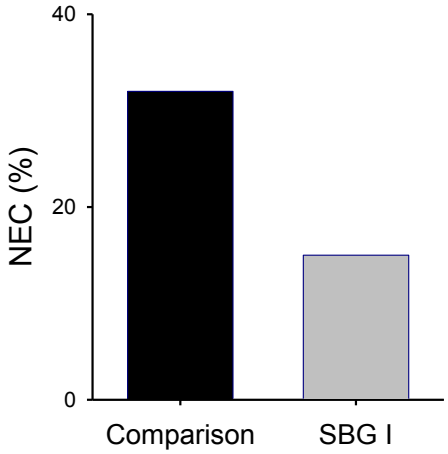

Figure 4. Rate of NEC. SBG I tended to be lower than comparison, p=0.07

Conclusions

We have shown that implementing a standardized guideline for the care of the infant born at the threshold of viability reduces the incidence of short-term morbidities and improves patient outcomes. We speculate that the unified approach, particularly for the routine daily care of these infants, that is outlined in the SBG have resulted in a more cohesive culture regarding the delivery of neonatal intensive care to this patient population. We have now gone on to develop a dedicated pod within our NICU for the ELGA patients. The pod is staffed by nurses and RTs that have agreed to follow the SBG in providing patient care. We currently make weekly small baby rounds to monitor adherence with the SBG and to highlight the importance of family-centered, developmentally appropriate care for these infants. Given the lack of evidence for the majority of our guidelines, the documented benefits to the patients are most likely not due to what these SBG dictate (i.e., particular interventions, medications, fluids, etc.), but rather from embracing a standardized approach to these patients. This uniform approach leads to a consistent attitude toward these patients. We strongly suggest that institutions, particularly large institutions like ours, adopt a unified and cohesive strategy when dealing with these patients. Indeed, it would benefit these patients for neonatal healthcare providers to come together to design and implement national guidelines for the care of the infant born at the threshold of viability. This might be best done through existing national organizations. Furthermore, it is now imperative that the field of neonatology designs and implements the clinical studies that will provide the evidence to base national guidelines on so that we can further improve the outcomes of these highly vulnerable patients. These are the steps that will be needed to further impact the survival and ultimate neurodevelopmental outcomes of the infant born at the threshold of viability.

References

1. Heron M, Sutton PD, Xu J, Ventura SJ, Strobino DM, Guyer B. Annual summary of vital statistics: 2007. Pediatrics. 2010;125(1):4-15.
2. Eichenwald EC, Stark AR. Management and outcomes of very low birth weight. N Engl J Med. 2008;358(16):1700-1711.
3. Lucey JF, Rowan CA, Shiono P, Wilkinson AR, Kilpatrick S, Payne NR, Horbar J, Carpenter J, Rogowski J, Soll RF. Fetal infants: the fate of 4172 infants with birth weights of 401 to 500 grams--the Vermont Oxford Network experience (1996-2000). Pediatrics. 2004;113(6):1559-1566.

4. Hoekstra RE, Ferrara TB, Couser RJ, Payne NR, Connett JE. Survival and long-term neurodevelopmental outcome of extremely premature infants born at 23-26 weeks' gestational age at a tertiary center. Pediatrics. 2004;113(1 Pt 1):e1-6.
5. Fanaroff AA, Stoll BJ, Wright LL, Carlo WA, Ehrenkranz RA, Stark AR, Bauer CR, Donovan EF, Korones SB, Laptook AR, Lemons JA, Oh W, Papile LA, Shankaran S, Stevenson DK, Tyson JE, Poole WK. Trends in neonatal morbidity and mortality for very low birthweight infants. Am J Obstet Gynecol. 2007;196(2):147 e141-148.
6. Tommiska V, Heinonen K, Lehtonen L, Renlund M, Saarela T, Tammela O, Virtanen M, Fellman V. No improvement in outcome of nationwide extremely low birth weight infant populations between 1996-1997 and 1999-2000. Pediatrics. 2007;119(1):29-36.
7. Moore KA, Coker K, DuBuisson AB, Swett B, Edwards WH. Implementing potentially better practices for improving family-centered care in neonatal intensive care units: successes and challenges. Pediatrics. 2003;111(4 Pt 2):e450-460.
8. Pollack LD, Ratner IM, Lund GC. United States neonatology practice survey: personnel, practice, hospital, and neonatal intensive care unit characteristics. Pediatrics. 1998;101(3 Pt 1):398-405.
9. Fonarow GC, Abraham WT, Albert NM, Stough WG, Gheorghiade M, Greenberg BH, O'Connor CM, Sun JL, Yancy C, Young JB. Carvedilol use at discharge in patients hospitalized for heart failure is associated with improved survival: an analysis from Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure (OPTIMIZE-HF). Am Heart J. 2007;153(1):82 e81-11.
10. Schwamm LH, Fonarow GC, Reeves MJ, Pan W, Frankel MR, Smith EE, Ellrodt G, Cannon CP, Liang L, Peterson E, Labresh KA. Get With the Guidelines-Stroke is associated with sustained improvement in care for patients hospitalized with acute stroke or transient ischemic attack. Circulation. 2009;119(1):107-115.
11. Cloutier MM, Hall CB, Wakefield DB, Bailit H. Use of asthma guidelines by primary care providers to reduce hospitalizations and emergency department visits in poor, minority, urban children. J Pediatr. 2005;146(5):591-597.
12. Thorsteinsdottir B, Volcheck GW, Enemark Madsen B, Patel AM, Li JT, Lim KG. The ABCs of asthma control. Mayo Clin Proc. 2008;83(7):814-820.
13. Merritt TA, Gold M, Holland J. A critical evaluation of clinical practice guidelines in neonatal medicine: does their use improve quality and lower costs? J Eval Clin Pract. 1999;5(2):169-177.
14. Obladen M, Metze B, Henrich W, Aktas A, Czernik C, Schulz-Baldes A. Interdisciplinary surveillance of intraventricular haemorrhage associated conditions in infants <1000 g. Acta Paediatr. 2008;97(6):731-737.
15. Jobe AH, Bancalari E. Bronchopulmonary dysplasia. Am J Respir Crit Care Med. 2001;163(7):1723-1729.
16. Walsh MC, Szefler S, Davis J, Allen M, Van Marter L, Abman S, Blackmon L, Jobe A. Summary proceedings from the bronchopulmonary dysplasia group. Pediatrics. 2006;117(3 Pt 2):S52-56.
17. Ehrenkranz RA, Walsh MC, Vohr BR, Jobe AH, Wright LL, Fanaroff AA, Wrage LA,

Poole K. Validation of the National Institutes of Health consensus definition of bronchopulmonary dysplasia. Pediatrics. 2005;116(6):1353-1360.
18. Jobe AJ. The new BPD: an arrest of lung development. Pediatr Res. 1999;46(6):641-643.
19. Schmidt B, Roberts RS, Davis P, Doyle LW, Barrington KJ, Ohlsson A, Solimano A, Tin W. Caffeine therapy for apnea of prematurity. N Engl J Med. 2006; 354(20):2112-2121.
20. Schmidt B, Roberts RS, Davis P, Doyle LW, Barrington KJ, Ohlsson A, Solimano A, Tin W. Long-term effects of caffeine therapy for apnea of prematurity. N Engl J Med. 2007;357(19):1893-1902.
21. Bell E, MJ A. Restricted versus liberal water intake for preventing morbidity and mortality in preterm infants. Cochrane Database Syst Rev. 2001;3 (CD000503).
22. Oh W, Poindexter BB, Perritt R, Lemons JA, Bauer CR, Ehrenkranz RA, Stoll BJ, Poole K, Wright LL. Association between fluid intake and weight loss during the first ten days of life and risk of bronchopulmonary dysplasia in extremely low birth weight infants. J Pediatr. 2005;147:786-790.
23. Agren J, Sjors G, Sedin G. Transepidermal water loss in infants born at 24 and 25 weeks of gestation. Acta Paediatr. 1998;87(11):1185-1190.
24. Kjartansson S, Arsan S, Hammarlund K, Sjors G, Sedin G. Water loss from the skin of term and preterm infants nursed under a radiant heater. Pediatr Res. 1995;37(2):233-238.
25. Sedin G. To avoid heat loss in very preterm infants. J Pediatr. 2004;145(6):720-722.
26. Tyson JE, Wright LL, Oh W, Kennedy KA, Mele L, Ehrenkranz RA, Stoll BJ, Lemons JA, Stevenson DK, Bauer CR, Korones SB, Fanaroff AA. Vitamin A supplementation for extremely-low-birth-weight infants. National Institute of Child Health and Human Development Neonatal Research Network. N Engl J Med. 1999; 340(25):1962-1968.
27. Shenai JP. Vitamin A supplementation in very low birth weight neonates: rationale and evidence. Pediatrics. 1999;104(6):1369-1374.
28. Volpe J. Intracranial hemorrhage: Germinal matrix-intraventricular hemorrhage. Neurology of the Newborn. 2001;4th Edition, WB Saunders, Philadelphia, p 428-430.
29. Ahmann PA, Lazzara A, Dykes FD, Brann AW, Jr., Schwartz JF. Intraventricular hemorrhage in the high-risk preterm infant: incidence and outcome. Ann Neurol. 1980;7(2):118-124.
30. Vohr BR, Wright LL, Dusick AM, Perritt R, Poole WK, Tyson JE, Steichen JJ, Bauer CR, Wilson-Costello DE, Mayes LC. Center differences and outcomes of extremely low birth weight infants. Pediatrics. 2004;113(4):781-789.
31. Fowlie PW, Davis PG, McGuire W. Prophylactic intravenous indomethacin for preventing mortality and morbidity in preterm infants. Cochrane Database Syst Rev. 2010 Jul 7;(7):CD000174.
32. Clyman R, Cassady G, Kirklin JK, Collins M, Philips JB. The role of patient ductus arteriosus ligation in bronchopulmonary dysplasia: reexamining a randomized controlled trial. J Pediatr 154: 873-876, 2009.
33. Madan JC, Kendrick D, Hagadorn JI, Frantz ID 3rd; National Institute of Child Health and Human Development Neonatal Research Network. Patent ductus arteriosus therapy: impact on neonatal and 18-month outcome. Pediatrics. 123:674-81, 2009.
34. Anand KJ, Hickey PR. Pain and its effects in the human neonate and fetus. N Engl J Med. 1987;317(21):1321-1329.
35. Barker DP, Rutter N. Exposure to invasive procedures in neonatal intensive care unit admissions. Arch Dis Child Fetal Neonatal Ed. 1995;72(1):F47-48.
36. Anand KJ, Hall RW, Desai N, Shephard B, Bergqvist LL, Young TE, Boyle EM, Carbajal R, Bhutani VK, Moore MB, Kronsberg SS, Barton BA. Effects of morphine analgesia in ventilated preterm neonates: primary outcomes from the NEOPAIN randomised trial. Lancet. 2004;363(9422):1673-1682.
37. Bellu R, de Waal KA, Zanini R. Opioids for neonates receiving mechanical ventilation. Cochrane Database Syst Rev. 2008(1):CD004212.
38. Carbajal R, Veerapen S, Couderc S, Jugie M, Ville Y. Analgesic effect of breast feeding in term neonates: randomised controlled trial. BMJ. 2003;326(7379):13.
39. Mathew PJ, Mathew JL. Assessment and management of pain in infants. Postgrad Med J. 2003;79(934):438-443.
40. Kosloske AM, Musemeche CA. Necrotizing enterocolitis of the neonate. Clin Perinatol. 1989;16(1):97-111.
41. Wilson R, Kanto WP, Jr., McCarthy BJ, Burton T, Lewin P, Terry J, Feldman RA. Epidemiologic characteristics of necrotizing enterocolitis: a population-based study. Am J Epidemiol. 1981;114(6):880-887.
42. Rees CM, Pierro A, Eaton S. Neurodevelopmental outcomes of neonates with medically and surgically treated necrotizing enterocolitis. Arch Dis Child Fetal Neonatal Ed. 2007;92(3):F193-198.
43. Bell MJ. Neonatal necrotizing enterocolitis. N Engl J Med. 1978;298(5):281-282.
44. Bell MJ, Ternberg JL, Feigin RD, Keating JP, Marshall R, Barton L, Brotherton T. Neonatal necrotizing enterocolitis. Therapeutic decisions based upon clinical staging. Ann Surg. 1978;187(1):1-7.
45. Sisk PM, Lovelady CA, Dillard RG, Gruber KJ,O'Shea TM. Early human milk feeding is associated with a lower risk of necrotizing enterocolitis in very low birth weight infants. J Perinatol 2007; 27: 428-433..
46. Vohr BR, Poindexter BB, Dusick AM, McKinley LT, Higgins RD, Langer JC, Poole WK. Persistent beneficial effects of breast milk ingested in the neonatal intensive care unit on outcomes of extremely low birth weight infants at 30 months of age. Pediatrics. 2007;120(4):e953-959.
47. Vohr BR, Poindexter BB, Dusick AM, McKinley LT, Wright LL, Langer JC, Poole WK. Beneficial effects of breast milk in the neonatal intensive care unit on the developmental outcome of extremely low birth weight infants at 18 months of age. Pediatrics. 2006;118(1):e115-123.
48. Schanler RJ, Shulman RJ, Lau C, Smith EO, Heitkemper MM. Feeding strategies for premature infants: randomized trial of gastrointestinal priming and tube-feeding method. Pediatrics. 1999;103(2):434-439.
49. Tyson JE, Kennedy KA. Minimal enteral nutrition for promoting feeding tolerance and preventing morbidity in parenterally fed infants. Cochrane Database Syst Rev. 2000(2):CD000504.
50. Arslanoglu S, Ziegler EE, Moro GE, World Association of Perinatal Medicine Working Group on Nutrition. Donor human milk in preterm feeding: evidence and recommendations. J Perinat Med 2010; 38:347-351.
51. Patole SK, deKlerk N. Impact of standardized feeding regimens on incidence of neonatal necrotising enterocolitis: a systematic review and meta-analysis of observational studies. Arch Dis Child Fetal Neonatal Ed 2005; 90: F147-F151.
52. Reber KM, Nankervis CA. Necrotizing enterocolitis: preventative strategies. Clin Perinatol 2004: 31: 157-167.

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Neonatology 'Apps' on Smart Phones
(Introduction to Neonatal Applications on Mobile Technology)

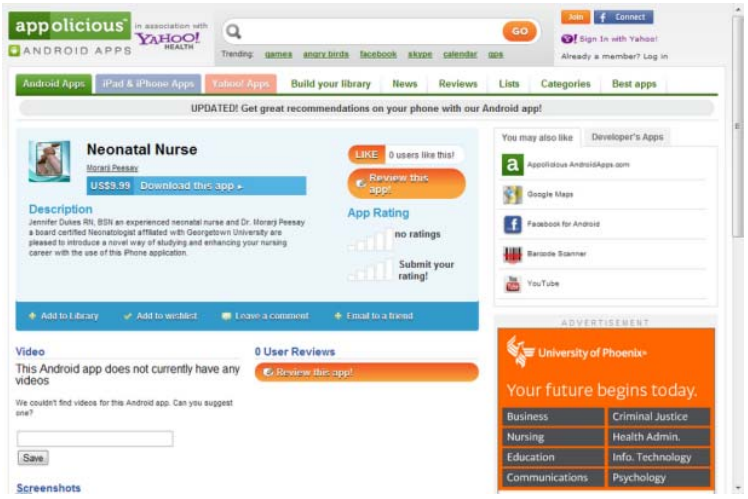
By Morarji Peesay, MD; Nitin R. Mehta, MD and Jennifer Dukes, BSN, RNC-NIC

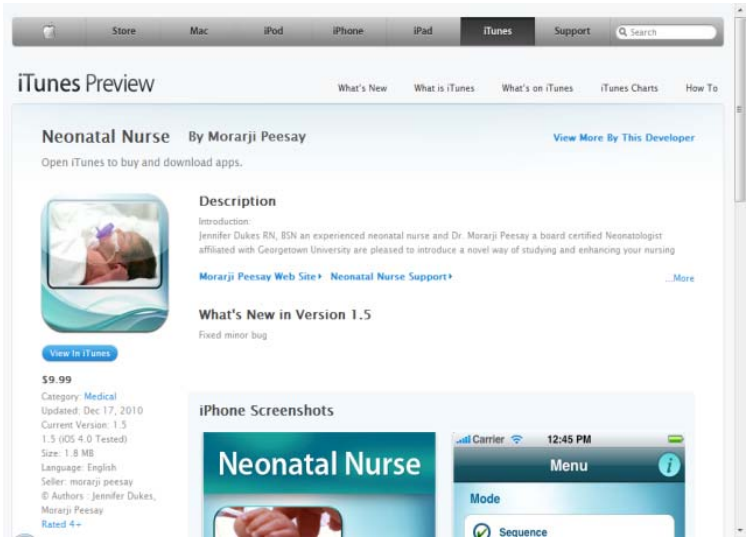
Neonatologists are good at multitasking when it comes to neonatal care, but not with smart phone mobile technology, I suppose. Their lifestyle seems to be 'not on the run' as much as others.

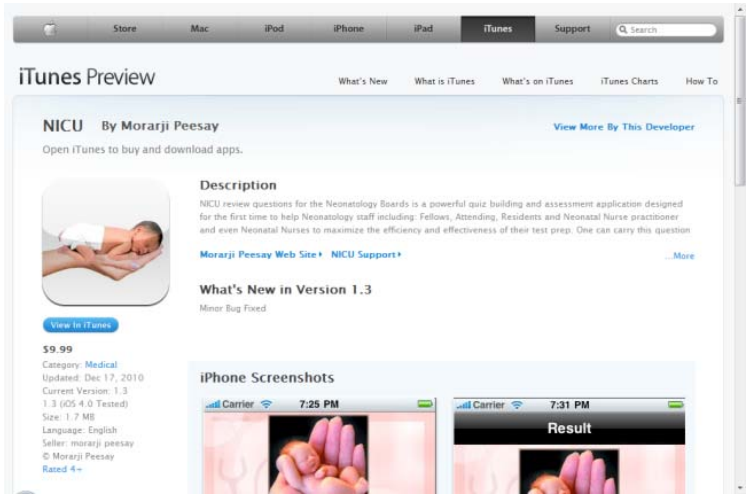
A smart phone is a mobile phone that offers a more advanced computing ability and connectivity than the contemporary, basic-feature phones as used in the past. Like PDA's, smart phones can be used for personal education and enhance a person's academic life. Smart phones seem to carry an endless database in your hand that can be used bedside and anywhere on the move. Smart phone 'apps' (applications) can be filled with a wealth of knowledge all lying at our finger tips.

An 'app' is an abbreviation for an application software. There are about 300,000 apps currently available for the iPhone and the number is growing fast. While most feature phones are able to run applications based on platforms such as Java, a smart phone usually allows the user to install and run more advanced applications (apps).

The use of computer technology in the field of neonatology and healthcare seems to have begun in and around the 1960s. However, it has been until recently that the use of computers and com-







Top Left: App on Blackberry; Top Right: App on Droid. Bottom Left and Right: App on iPhone

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puter applications has begun to emerge as commonplace. It has always been and continues to be team work that delivers effective treatment with positive outcomes in Neonatal Intensive Care Units. Teams striving to practice evidence-based medicine is what allowed neonatology to mature rapidly over only a few decades. Interdisciplinary teams comprised of neonatologists, neonatal nurses, respiratory therapists as well as other ancillary staff have traditionally worked together to provide the best of care with the most updated technology and services there are to offer.

In today's world of ever changing and evolving technology in the care we deliver, does it not make sense that we should embrace technology in every way? There are computer applications for everything you can imagine. Our society has welcomed and accepted the use of technological devices in all settings of life. One can read a book, track one's weight, look up a fact, play a game, take a picture, send an email, all from the palm of one's hand. As healthcare providers, having information at our fingertips is now becoming more easily accessible.

The goal of any neonatology app should be to allow the sharing of knowledge in the neonatology community with ease of use in mind. The apps can be multimedia teaching tools geared towards neonatal fellows, neonatal nurse practitioners, residents, nurses, as well as students. They are also available worldwide. The idea for the apps is to allow for well-focussed concise study material to be accessible in the palm of your hand wherever you happen to be.

As more media technology advances, it makes sense for us to utilize our resources for reaching out and educating others in our field. All advancements in healthcare have occurred as the result of knowledge sharing. What better way to share knowledge than in the setting in which the the up-and-coming generation will be most familiar? In neonatology in particular which has grown tremendously over just the past ten years, we should be open to viewing other modes of learning such as this. The value of using this type of technology (personal devices such as iPad, mobile phones and iPods) lies in the freedom available to the end-user to take advantage of medical applications to conduct data searches, etc. at the bedside. One can also get close to diagnosis and utilize photo video ability upload to the other higher level of diagnosticians to help with diagnosis and thus early referral to tertiary care. This way we will be inching towards better patient care.

This decade has been the pinnacle of the "Information Revolution." It is through the use of mobile application technology that I sought to introduce and share my neonatology knowledge globally.

Examples of the impact of iPhone apps specifically designed for NICU users and currently available since 2009 are: "NICU," "Neonatal Nurse," "APGAR Score" and "OB/Newborn Critical," and yet the usage pattern suggests the utility being recognized and increasing popularity does not get affected by geographic borders. Over a very short period, users on all continents have recognized these apps and their potential. A few examples of iPhone apps are:

- iPhone App: "NICU" 2009; Dr. Morarji Peesay; Neonatology Multiple Choice Questions and Answers. Also published in Droid and Blackberry phones.
- iPhone App: "Neonatal Nurse" 2009; Dr. Morarji Peesay/ Jennifer Dukes RN; Neonatology Multiple Choice Questions and Answers. Also published in Droid and Blackberry phones.
- iPhone App: "APGAR Timer" 2009; Patrick Verloo.
- iPhone App: "OB/Newborn Critical Thinking" 2009; Layered Learning LLC.

These apps have enormous potential for mobile education. They also can be used to bring all neonatologists together seamlessly on one platform. Mobile education is a rapidly growing field. The potential uses for mobile technology in healthcare are extensive. The future creation of applications that can encompass diagnostic tools as well as search engines for information retrieval specific to neonatology are vital to the future of the field. Just as we have evolved in the way we manage and treat our patients with technology and evidenced-based medicine we utilize and practice, so too, will we move forward in our ways of communicating and sharing our ideas.

References

1. Mayer T. E-prescribing hits the medical world: what physicians need to know to get the right technology. J Med Pract Manage. Sep-Oct 2001;17(2):103-5.
2. Guerra A. Handheld health. UHC is providing residents with Palm handhelds to stay competitive and enhance care. Healthc Inform. Sep 2006;23(9):73.
3. Jotkowitz A, Oh J, Tu C, Elkin D, Pollack LA, Kerpen H. The use of personal digital assistants among medical residents. Med Teach. Jun 2006;28(4):382-4.
4. Kiel JM, Goldblum OM. Using personal digital assistants to enhance outcomes. J HealthcInf Manag. Fall 2001; 15(3):237-50.
5. Rosenblum M. Medical error reduction and PDAs. International Pediatrics [serial online]. 2003;18:69-77.
6. Koeniger-Donohue, R. (2008). Handheld computers in nursing education: A PDA pilot project. The Journal of Nursing Education, 47, 74–78.
7. Kim, S. H., Holmes, K., & Mims, C. (2005). Mobile wireless technology use and implementation: Opening a dialogue on the new technologies in education. TechTrends, 49(3), 54–63.
8. Cimino, J. J., & Bakken, S. (2005). Personal digital educators. The New England Journal of Medicine, 352, 860–863.
9. Metcalf, D. S. (2006). mLearning: Mobile learning and performance in the palm of your hand. Amherst, MA: HRD Press.

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Digital Version of ER Pediatric Response Chart Created

A well-known paper-based medical chart used by pediatric emergency personnel across America is undergoing a 21st century boost in an collaborative effort between Virginia Tech's College of Engineering, Roanoke-based Carilion Clinic Children's Hospital, and the physician who created the original method some 25 years ago.

The Broselow Pediatric Emergency Tape – otherwise known as the Broselow Tape -- has been a staple of ERs and child trauma units for nearly three decades. Created by Hickory, NC-based physician James Broselow, the Broselow Tape is a long, durable tape measure used on a child during a medical emergency. Using a color coded-format, it provides specific medical instructions – amounts of medicines to dispense or level of shock voltage to emit from a defibrillator, for instance – to medical caregivers based on the height and then subsequent weight of the child.

This information now will be displayed on a large LCD monitor within emergency rooms, for all personnel to see.

"We are converting the existing Broselow Tape into an electronic format to improve resuscitation team communications and patient safety," said Andre A. Muelenaer Jr., Associate Professor of Pediatrics at the Virginia Tech Carilion School of Medicine, Adjunct Professor at Virginia Tech-Wake Forrest University School of Biomedical Engineering and Science and Director of the Pediatric Medical Device Institute, located in Roanoke, VA.

Additional displayed information will include medicines administered to the patient, including the time of administration and the next scheduled allotment. In the instance of burns, an automated calculation of the affected surface area will be displayed, along with automated calculation of fluid resuscitation.

A click of a mouse/remote control can move responders from one screen to another. The software running the newly-dubbed eBroselow software program runs on LabVIEW, owned by National Instruments. Known as TEAM Broselow, the method is being tested at various hospitals, including facilities in Roanoke, VA, Austin, Texas, and Winston-Salem, NC, and will be fine tuned as additional input comes in from doctors, nurses and other medical personnel, said Muelenaer.

Many of the new features already include input from medical personnel around the country, Muelenaer said. One example is the ability to track by barcode-scan the exact types and amounts of medicine administered to the patient. "The idea is to give multiple people access to the same info, on a big screen," said Al Wicks, Associate Professor of Mechanical Engineering at Virginia Tech, who serves on the Pediatric Medical Device Institute's leadership team with Muelenaer.

Much of the work to digitize the Broselow Tape for display on LCD televisions was completed by Carlos Guevara, a Virginia Tech master's student in mechanical engineering from El Salvador who recently became an American citizen. Emergency medical personnel still will rely on the physical laminated tape to determine the child's care-need level, before utilizing the digital display version.

"Doing this was a rather simple task," said Guevara. "The challenges arose in an attempt to take advantage of current technology in order to develop a much more enhanced device, such as using the available drug concentration information to calculate volume to administer once a drug has been scanned."

The idea for a digital version of the Broselow Tape came two-fold, hundreds of miles apart. In Hickory, Broselow was working with a collaborator on a Web-based adaptation as far back as three years ago. Meanwhile, more than a year ago, Stacy Steans, a pediatric physician at Roanoke's Carilion Clinic Children's Hospital, had his own epiphany about converting the paper-based data to a wireless format displayed on a monitor. Eventually, Steans and Muelenaer at Carilion, the Virginia Tech College of Engineering and Broselow himself all came together to work on the process.

"We showed them what we had developed and they showed us what they had developed," said Broselow, who developed the tape after moving from a private practice set-up to the Emergency Room, and seeing the need for large medical teams to have set standards for child emergency care response. "The initial content on the large screen was a combination of what their thinking was and the content information we had."

Funding for the project came from the Childress Institute for Pediatric Trauma. Rural hospitals, such as those located throughout Southwest Virginia, could benefit most from the software device, more so than urban hospitals with high-capita populations of children. "There are not as many children, so there are not as many cases," he said.

The tape itself is designed for children 12-years-old or younger, and having a maximum weight of roughly 80 pounds. Separately, Broselow and his company are continuing work on several digital formats for emergency rooms of all types and additional user formats such as iPhone applications and several publications, plus additional emergency response needs such as wounds sustained from chemical weapons.

WINNER of Neonatology Today's "GO GREEN" Drawing is:

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Watch for other drawings from Neonatology Today

Global Neonatology Today: A Monthly Column: *The 2010 Millennium Development Goal Summit*

By Dharmapuri Vidyasagar, MD, FAAP, FCCM

During September 20th - 22nd, 2010, world leaders gathered in New York City to discuss the progress of MDGs (Millennium Development Goals) around the globe. Since the inception of the MDG Project ten years ago, the world has seen many dramatic geopolitical and economic crises. In 2010, the world is different than it was a decade ago. The work towards achieving the MDGs has been affected in many ways; although, overall, there has been ongoing progress in many areas. The body of nations and national leaders at the summit reviewed the successes and weaknesses of the program, and deliberated on how to maintain the course to achieve the MDGs by the targeted date of 2015.

There is Good News in the Areas of Infection Control (MDG #6)

The AIDS epidemic is beginning to change course. The number of people newly infected with HIV is declining, and AIDS-related deaths are decreasing. New HIV infections have fallen by nearly 20% in the last 10 years, AIDS-related deaths are down by nearly 20% in the last five years, and the total number of people living with HIV is stabilizing. Secretary-General Ban Ki-moon stated in his message for World AIDS Day, "We have finally reached the first part of Millennium Development Goal #6 by halting and beginning to reverse the spread of HIV."

He continued his speech, adding that a new initiative, *Global Plan to Stop TB 20ll-2015*, is designed to combat tuberculosis (TB), which claims the lives of nearly two million people worldwide every year, and could lead the way towards eliminating the disease altogether, if governments and donors commit enough funds.

"There is an urgent need to scale-up action against TB. Ten million people, including four million women and children, will lose their lives unnecessarily between now and 2015 if we fail," said Dr. Margaret Chan, WHO's Director-General who hosts the *Stop TB Partnership*.

Donors (countries, foundations and corporations) pledged billions to fight AIDS, TB, and Malaria at the October UN meeting. A total of $11.7 billion was pledged in new funding over the next three years to support the *Global Fund to Fight AIDS, Tuberculosis and Malaria*. This largest-ever pledge for the collective effort to fight the three pandemics will allow the *Global Fund* to further support countries as they work to meet the MDGs related to health.

"At a time when so many governments are tightening their belts at home, these commitments send a powerful message. It shows how seriously world leaders want to do the right thing beyond their borders," said UN Secretary-General Ban Ki-moon in a statement.

Advocates stated that the world is different from when the MDGs were initiated. The programs have been affected by many economic trends slowing the progress seen in early years in both wealthy and poor countries, triggering fears among many that the MDGs that were by definition aspirational, have become even harder to reach. Yet, while difficult, many countries have achieved their goals within the last decade.

More on The Summit Report in the next issue.

There is much more to be done, and "***The Clock is Ticking!***"

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