Developmental Care: The Impact of Wee Care Developmental Care Training on Short-term Infant Outcome and Hospital Costs

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Abstract

This article explores the effect of a comprehensive developmental care training program on the medical outcome and cost of care for premature infants. Premature infants less than 34 weeks' gestation admitted to 2 regional neonatal intensive care units were prospective studies 6 months before and after implementation of the Wee Care program (Children's Medical Ventures, Norwell, MA). Environment, medical outcome, and hospital charges were recorded. The sample consisted of 242 infants (139 pre- and 103 postintervention). Although the medical outcomes of chronic lung disease, infection rate, mild retinopathy of prematurity, and intraventricular hemorrhage were significantly decreased, there was no change in incidence of severe retinopathy of prematurity. Hospital stay and hospital costs were significantly decreased. The authors conclude that a multidisciplinary, structured program in developmental care can lead to alterations in the neonatal intensive care unit environment associated with improved medical outcome, decreased length of hospitalization, and decreased cost of care.

Shortened hospitalizations and improved medical, as well as neurodevelopmental outcomes, have recently been observed with the use of individualized developmental care for premature infants in the neonatal intensive care unit (NICU).[1–6] Accounting for over 10% of all babies born in the United States,[7] premature infants make up greater than 70% of admissions to the NICU, which provides high level and expensive critical care. For the very low birth weight infant, less than 1,500 g, in which 90% survival is expected, the duration of stay in the NICU can be greater than 2 to 3 months, and discharge is associated with an increased risk of developmental delay and disabilities.[8–10] After discharge from the NICU, ambulatory care costs for these infants are high and at least half of the children will require special education classes. Over the past 10 years, medical research has provided evidence that premature infants with a developmentally appropriate environment, through individualized developmental care, can have improved medical outcome. This is associated with decreased intraventricular hemorrhage, decreased numbers of oxygen and ventilator days, decreased development of chronic lung disease, and decreased days of hospitalization.[11–14] It is controversial, however, if these medical improvements translate to decreased long-term disabilities.

The Newborn Individualized Developmental Care and Assessment Program (NIDCAP) model provides education and specific training for individual health professionals with the goal of an altered developmental approach to care in the NICU and Special Care Nursery. The NIDCAP Program trains selected individuals to observe the infants' strengths and needs in the areas of sleep/wake states, physiologic and motor organization as well as reactivity to environmental and social stressors. The NIDCAP trained individual provides specific

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recommendations for environmental modification, such as appropriate handling and positioning as well as adjustments based on understanding infant cues.[15,16] In this model, the shift in the NICU to developmental and family-centered practices is dependent on caregivers being individually trained in NIDCAP and in sharing this knowledge with their staff. Typically the training for each individual involves a 3- to 5-year educational, hands-on process. Despite supportive evidence of the effect of this approach to training and care, the current NICU environment in many centers continues to be tailored to care givers. Little attention is paid to the NICU environment and the potential medical impact of light, sound, or handling on premature infant outcome.

In our NICU, family-centered care was implemented in 1992. We hypothesized that the provision of a developmentally appropriate environment for the premature and critically ill infant combined with our current family-centered care practices would play a key role in decreasing the morbidity associated with NICU care. Thus, improving medical outcome while decreasing the high hospital cost for these infants. We further hypothesized that the Wee Care intervention model of a structured 3-day multidisciplinary structured program in developmental care (Wee Care Neonatal Systems Training Program, Children's Medical Ventures, Norwell, MA) that involved all individuals who cared for premature infants would be most appropriate for our NICU. In this model, we expected a quick and dramatic change in the overall functioning of the NICU. We speculated that these changes would translate to improved medical outcome, decreased length of infant hospitalization, and cost saving.

Methods

Intervention

Wee Care Neonatal Developmental Care was used to specifically design an educational program for the hospital staff that provided didactic and hands-on education related to developmental needs of the premature infant. The program involved an initial in-hospital 3-day multidisciplinary instruction for all individuals involved in the care of NICU infants. This included staff from custodial services, radiology, laboratory, phlebotomy, nursing, occupational and physical therapy, nutrition, pharmacy, as well as nursing and medical staff who consulted in the care of infants. The program worked with our NICU medical and nursing staff to tailor instruction in 3 aspects of developmental care practices: 1) the physical environment, 2) understanding infant developmental needs, and 3) integration of these practices in an already functioning family-centered care program.

Instruction in the physical environment included recommended techniques to decrease light and sound levels in the NICU. Brightness recommendations were to aim for light levels of <60 foot candles (FCs). Light meters were used to assess level of brightness. Brightness was measured in the corners and windowed areas in the NICU, where infant beds were maintained, and directly around infants. Sound levels were determined in incubators and during daily activities in the NICU. Sound level, measured by sound meter, was aimed at <58 db during all activities. To identify infant cues related to stress, lectures focused on infant developmental responses, and specific in-service seminars were given to identify specific handling techniques that would decrease infant stress such as the technique of midline flexion support.

Finally, approaches to integrate developmental care practices in an already functioning family-centered care program were discussed and implemented. Emphasis was placed on inclusion of parents as part of the NICU care team, as well as strategies to educate the NICU staff and parents in accepting altered parental roles to facilitate participation in developmental care practices. Specially targeted didactic training sessions were provided with consideration of the varied staff education and background of NICU care. Specific sessions focused on education for physicians and nurses. Hands-on sessions were provided during all hospital shifts by the Children's Medical Ventures' Wee Care team. At the end of the training sessions, developmental care committees were formed and contact was maintained with the Children's Medical Venture Wee Care team for 1 year to reinforce the training program and address ongoing specific environmental questions.

Population

All infants less than 34 weeks admitted to an Urban Regional Perinatal Center (RPC) 6 months before and after the intervention period were identified. The regional perinatal center is a uniquely joined RPC composed of 2 geographically close level III NICUs, 1 a private NICU at New York University Medical Center Tisch Hospital and 1 a public hospital NICU at Bellevue Hospital Center. The RPC is composed of a total of 54 NICU beds, 29 beds at Tisch Hospital, and 25 beds at Bellevue Hospital Center. The medical coverage and medical guidelines for care of the 2 NICUs are identical. The nursing staff coverage is shared at many levels. All other ancillary services of the 2 NICUs are completely separated.

Data Analysis

Data were collected and included an infant's hospital course, incidence of intraventricular hemorrhage, incidence of retinopathy of prematurity, incidence of late infection, incidence of chronic lung disease (need for oxygen at 36 weeks corrected), length of hospitalization, physician financial data, and infant short-term acute medical outcome. NICU light and sound levels were recorded with light and sound meters. Photographs of infant care were obtained before and after the intervention. Standard descriptive statistics were used to summarize the study variables. Groups were compared by using *t* test for continuous variables or chi square test for discrete variables. Statistical significance was defined as $P < .05$.

Results

General Characteristics of Population

A total of 242 infants less than 34 weeks' gestation were included in the study. One hundred thirty nine infants were included before the intervention and 103 infants were included after the intervention. One hundred infants were from Bellevue Hospital Center's NICU and 142 infants from Tisch Hospital's NICU. A total of 97 infants were less than 30 weeks' gestation. Sixty infants less than 30 weeks' gestation were admitted before the intervention and 37 infants less than 30 weeks' gestation were included after the intervention. There were no statistically significant differences between the 2 groups before or after the intervention. There were no additional medical changes during the intervention. The demographic characteristics of the group are shown in Tables 1 and 2.

Effect of Intervention on the NICU Environment

Sound and Light

Sound levels were decreased to <58 db to provide a quiet environment to facilitate growth and to decrease infant stress in the NICU. To accomplish these aims, the following changes were made: individual beepers to vibration mode, decreased NICU telephone and alarm volumes, cushioning garbage cans, and moving or changing printers. The staff was instructed to decrease voice volume during all communication near infants including communication occurring during rounds. Emphasis was made to round away from the bedside. Sounds >80 db, such as sounds associated with cleaning, were minimized to less than 10-minute periods. Sound levels were evaluated during medical and nursing rounds and during quiet times in the NICUs. Sound was significantly decreased to below the recommended aims after the intervention (Table 3 and Fig 1).

Reduction in brightness was aimed at 1 to 60 foot-candles (FC)/day with an aim for 0.5 FC at night. To accomplish this change, lights overhead were dimmed or turned off unless needed, incubators were covered with blankets, and window shades were used to decrease brightness for individual rooms. In addition, infant eyes were covered with folded towels during procedures. As preterm infants matured, light was introduced slowly. Brightness was decreased significantly in room corners and at windows to <60 FC (Table 3 and Fig 2).

Positioning

Specific positioning aides (such as Children's Medical Ventures Bendy Bumpers and Snuggle Ups) were used to provide boundaries for the infants to facilitate normal positioning for appropriate muscle development. In addition, these aides were used to contain infants to decrease stress before, during, and after procedures. Photographs of the changes in infant positioning before and after the intervention are shown in Figures 3A and 3B.

Table 1. Demographic Data

	Pre	Post
Gestational age in weeks	28.6 ± 4.1	28.5 ± 3.6
Average weight in grams	1293 ± 229	1270 ± 236
Male	75 (54%)	55 (53%)
Female	64 (46%)	48 (46%)
White	51 (37%)	43 (42%)
Black	17 (12%)	12 (12%)
Hispanic	51 (37%)	34 (33%)
Asian	16 (12%)	8 (8%)

Table 2. Average Group Weight in Grams ± SD

	Average Weight in Grams ± SD	
Gestational Age in Weeks	Pre	Post
24–27 weeks	728 ± 110	752 ± 125
28–30 weeks	1174 ± 248	1167 ± 241
31–34 weeks	1978 ± 331	1891 ± 342
Total	1293 ± 229	1270 ± 236

Table 3. Effect of Developmental Training on the NICU Environment

	Pre ± SD	Post ± SD
Light (FC)		
Corners	757 ± 38	33 ± 15
Windows	1490 ± 25	136 ± 50
Sound (db)		
Quiet time	69 ± 9	50 ± 4
Rounds	80 ± 9	56 ± 5

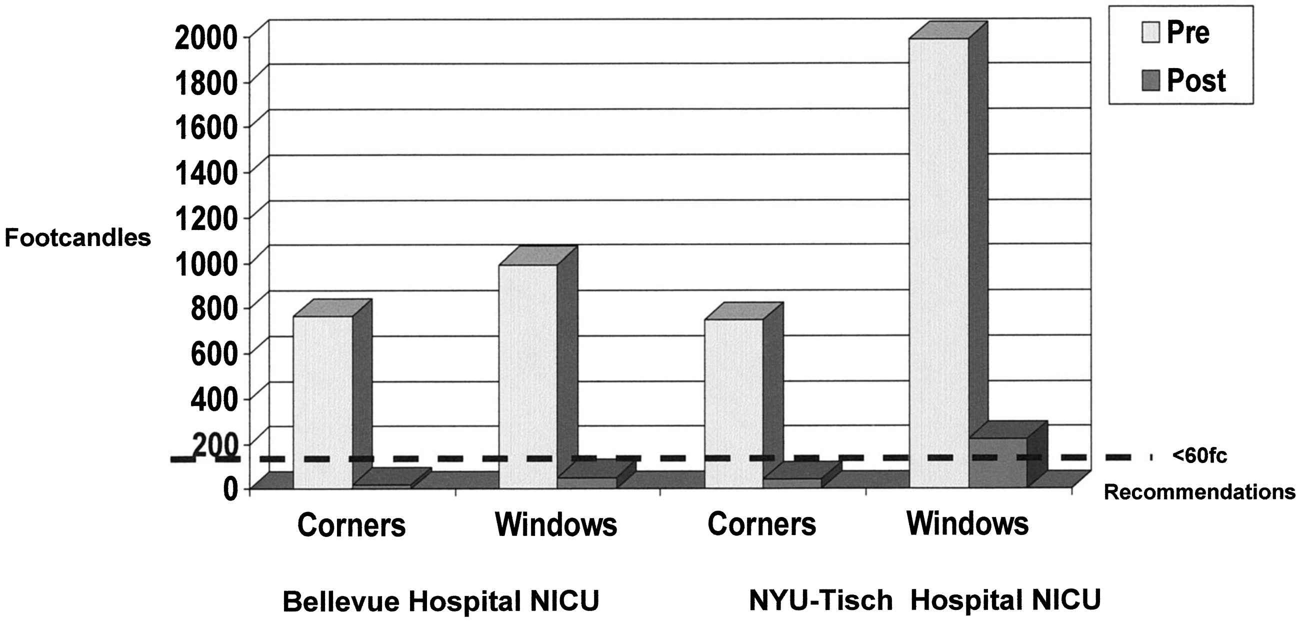

Fig 1. Average light levels pre and postimplementation of developmental training.

Effect of Intervention on Infant Outcome

During 1 year a total of 246 infants were identified, 142 before the intervention and 104 after the intervention. Four infants died. Three infants died before the intervention and 1 infant died after the intervention. Infants who received the intervention were less likely to have intraventricular hemorrhage and ROP $\leq$ Stage II. The intervention had little effect on ROP $>$ Stage II. No infant before or after the intervention required laser treatment for ROP. Finally, the intervention appeared to decrease the incidence of infection and chronic lung disease in the NICU (Fig 4).

Effect of Intervention on Length of Hospitalization and Hospital Cost

When length of hospital stay was evaluated, the intervention significantly decreased the length of stay for all infant categories and infants $<$1,500 g in the NICU (Table 4 and Fig 5).

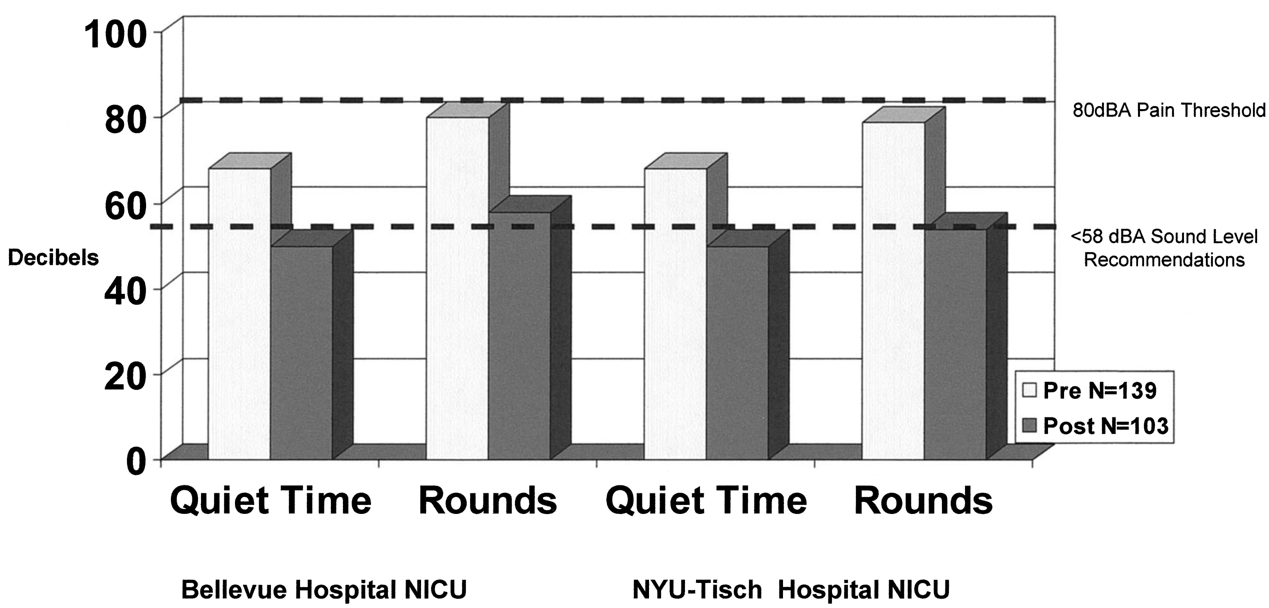

Fig 2. Average sound levels pre and postimplementation of developmental training.

Fig 3. The changes in infant positioning (A) before and (B) after the intervention.

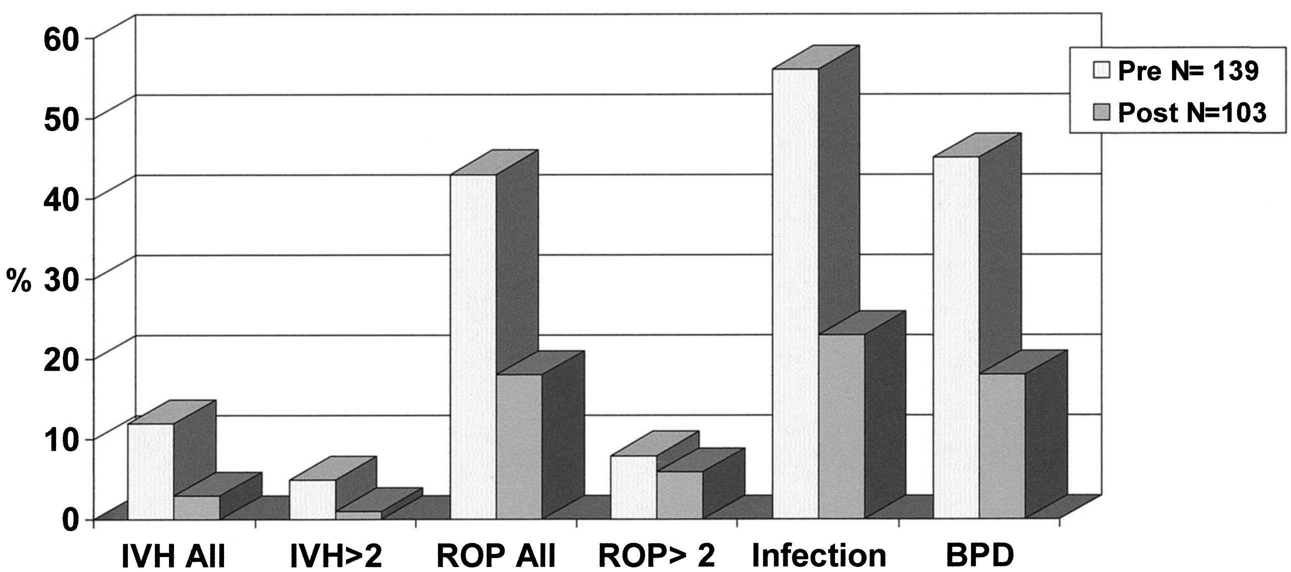

Fig 4. Effect of developmental training on low birth weight infant medical outcome.

Table 4. Effect of Developmental Training on Length of Stay

Gestational Age	Pre	Post
24–27 weeks	111 ± 28 (24)	67 ± 12 (17)
28–30 weeks	63 ± 22 (36)	42 ± 17 (20)
31–34 weeks	24 ± 15 (70)	14 ± 8 (66)
Total days ≤ 34 weeks	64 ± 22 (139)	41 ± 12 (103)

Note: Length of Stay in Days ± SD.

Table 5. Effect of Developmental Training on Hospital Costs

Gestational Age	Pre ± SD	Post ± SD
24–27 weeks	$165,750 ± $42,000	$100,500 ± $18,000
28–30 weeks	$94,500 ± $33,000	$60,750 ± $25,500
31–34 weeks	$36,000 ± $22,500	$21,000 ± $12,000
Total costs ≤ 34 weeks	$99,000 ± $29,250	$61,250 ± $18,500

Note: Estimate Cost at $1,500/day.

Cost of infant hospitalization, estimated at $1,500 per day was decreased in all infant categories (Tables 5 and 6).

Discussion

These results show that an alternative model of developmental care training can be effective in initiating immediate change in a NICU. The Wee Care program associated with an improved NICU environment, improved short-term infant medical outcome, decreased length of hospitalization, and decreased hospital costs. As anticipated, our family-centered care program was enhanced. This led to greater participation by parents with their babies, a policy change to increase visiting hours, and inclusion of parents as part of the care team. Specific barriers to implement the continuation of the program included initial staff attitude toward accepting this type of change in the NICU. Unlike implementation of a new ventilator, implementing a more global and individualized change for the unit had its challenges. Consulting physicians and individual NICU nurses required reassurance in the concept that these minor yet profound changes would not interfere with their philosophy of provision of care. At times, the program was not perceived to be an important medical technique required to care for infants, but as an optional program. It was difficult to incorporate the program into admission routines. Developmental care often took a back seat to baths, lead placements, or weighing infants. These barriers to care required constant individual and group training sessions to address principles of developmental care and the important impact of stress on outcome. At times, sessions included all physicians: neonatologists, residents, surgeons, and other medical consultants.

This instruction model was chosen because of lack of understanding of the importance of developmental care practices across all staff levels in our NICU. The inclusion of all

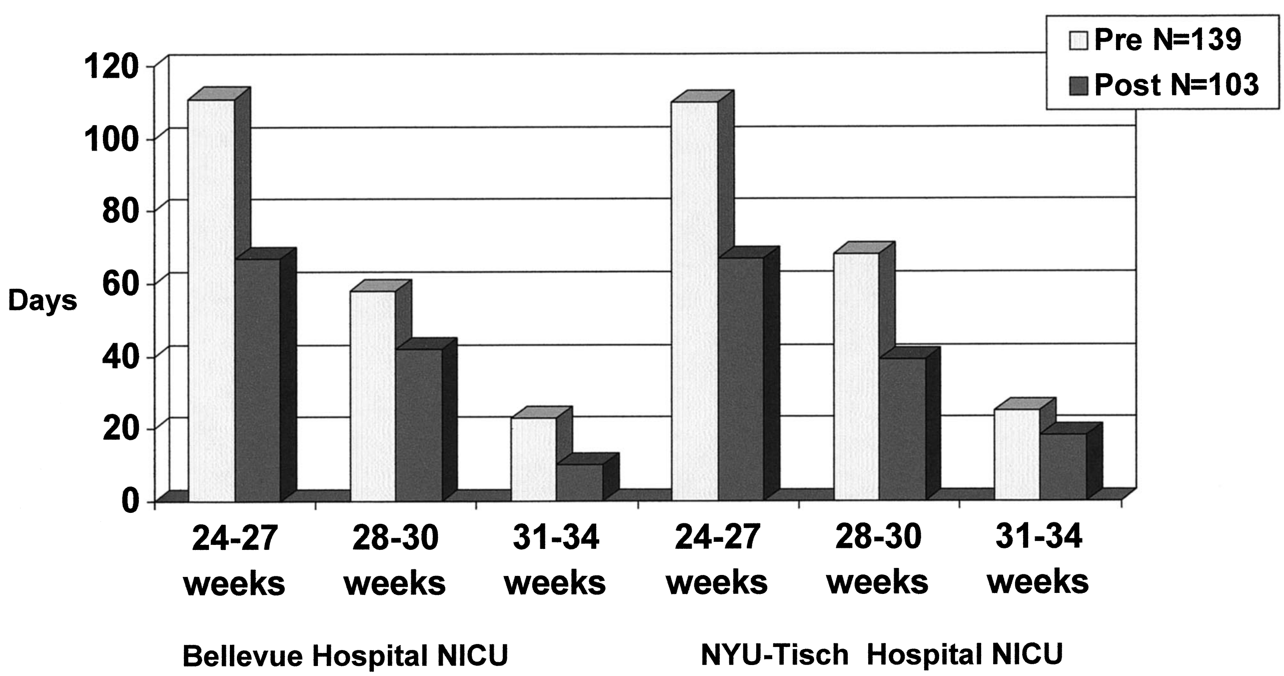

Fig 5. Length of hospitalization at each NICU, pre and postimplementation of developmental training.

Table 6. Effect of Developmental Training on Hospital Costs by NICU Site

	Bellevue Hospital		Tisch Hospital		RPC	
Gestational Age	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
24–27 weeks	$166,500	$100,500	$165,000	$100,500	$165,750	$100,500
28–30 weeks	$102,000	$58,500	$87,000	$63,000	$94,500	$60,750
31–34 weeks	$34,500	$15,000	$37,500	$27,000	$36,000	$21,000
Total cost ≤ 34 weeks	$96,000	$60,000	$102,000	$61,500	$99,000	$61,250

staff, regardless of level, in a 3-day educational event had the most profound effect on initiating change. Because every staff member was trained equally and thoroughly in developmental care concepts, practice changes occurred quickly and universally. Staff members also felt that their inclusion validated their importance with regard to the care provided in the NICU.

We speculate that long-term infant outcome after developmental care practices may be improved as a result of these techniques. We speculate further that formal implementation of even partial developmental care practices in NICUs could potentially lead to improved outcome by decreasing stress in the premature infant, which can also be associated with significant cost savings. We estimate conservatively that even a modest decrease of 1 hospital day for all very low birth weight infants (<1,500 g or <32 weeks of which approximately 50,700 infants were identified in 1995) would save the United States approximately $76 million.

For further information regarding children's Medical Ventures' Wee Care program, call 800-377-3449 or log on at www.childmed.com.

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