

volumes found in term and preterm infants. Using a brain segmentation scheme in conjunction with high-resolution volumetric imaging, the brain volumes of cerebrospinal fluid, cortical gray matter, white matter, subcortical gray matter, cerebellum, and brainstem were determined for each group and compared. In addition, a unique parcellation technique designed specifically for use in the newborn allowed the investigators to compare the term and preterm groups of infants with respect to regional cortical gray and white matter tissue volume. The preterm infants demonstrated smaller volumes of sensorimotor, parieto-occipital, and inferior occipital gray matter and larger volumes of dorsal prefrontal and anterior cortical gray matter than did the term infants. Parieto-occipital white matter volume was found to be larger in the left hemisphere and smaller on the right among preterms as compared with the term infants. Importantly, Bayley Scale scores of the infants obtained between 18 and 20 months of age and their neonatal MRI data were analyzed to detect correlations between the 2 bodies of data. Importantly, significant correlation between the mental subscale of the Bayley and white matter volume in the right sensorimotor and midtemporal regions was found. Thus, Peterson et al have provided evidence of important neurobehavioral features that correlate with regional brain volume differences that may exist between preterm infants and those born at term.

Peterson et al encountered the considerable challenges that confront all investigators who conduct developmental brain research in children using MRI and neurobehavioral methods. Both groups of infants studied were small in number. As a result, it is difficult to generalize differences found between the 2 groups to the larger population of term and preterm infants. In addition, in the group of 10 preterm infants, 9 had bronchopulmonary dysplasia, 3 represented multiple gestation pregnancies, and 4 had either intraventricular hemorrhage (grade not disclosed) or periventricular leukomalacia. Nine of the preterms were treated with steroids. Each of these features can affect gray or white matter development. As a result, it is difficult to ascribe the brain volume and behavioral differences found between the term and preterm infants to prematurity alone. The complications of premature birth and their treatment may have contributed to the reported group differences, as well.

Future studies should strive to distinguish even more clearly the aspects of brain development that may be affected by prematurity alone as opposed to its complications. Moreover, quantitative MRI studies of infants that seek correlation with subsequent behavior and cognition are likely to provide valuable insight into the organization of neural systems that underlie cognitive development in children. These "advanced" MRI tools, like the children studied by Peterson et al, are still in their infancy. Research capabilities will grow considerably as these methods are refined and improved. The view of human brain

development that they will provide shall be exciting, indeed.

MICHAEL J. RIVKIN, MD  
Developmental Neuroimaging Laboratory  
Departments of Neurology, Psychiatry, and Radiology  
Children's Hospital  
Boston, MA 02115

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## School Readiness: An Idea Whose Time Has Arrived

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ABBREVIATION. EMS, emergency medical service.

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**F**or more than 30 years, pediatrics has embraced early child development and school performance at older ages as an integral part of clinical practice. This growing focus on child development and school performance outcomes was informed in part by the changing epidemiology of children's health, the related reframing of the scope of pediatric practice under the construct of "new morbidities," and the influential 1987 report from the Task Force on Pediatric Education.<sup>1,2</sup> Child develop-

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Address correspondence to Barry Zuckerman, MD, Boston Medical Center 771 Albany St, Dowling 3509 South Boston, MA 02118. E-mail: barry.zuckerman@bmc.org

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ment has become a certified subspecialty, and residency programs have specified training requirements. Despite significant progress, even more needs to be done not only to identify children with developmental disabilities and institute appropriate and timely interventions, but also to promote optimal development and enhance the school readiness of all children.<sup>3</sup>

Our current understanding of the importance of early childhood is converging with our national policy agenda to improve educational opportunities and outcomes for all children. The convergence of these 2 trends is taking place under the banner of school readiness, referring both to a child's capacity to learn, grow, and achieve and also creating an organizing principle and outcome for major statewide early childhood initiatives throughout the United States. As a result, pediatricians will increasingly be called on to direct more of their clinical expertise in service of this important societal goal, and are likely to find themselves, as many other early childhood professionals and teachers are, increasingly involved in the "school readiness business." Underlying these observable changes in social policy are tectonic shifts in our understanding of the importance of early childhood and the role of school readiness in promoting not only academic achievement but longer term health outcomes.

Whereas before 1990 the term *school readiness* was used to evaluate and some would say to label children who were not "mature enough" to enter school, school readiness has been fundamentally redefined to reframe a set of major policy initiatives in the United States. In 1992, the National Education Goals Panel defined *school readiness* as consisting of 3 attributes: schools that were ready for children, children that were ready from schools, and parents and communities that could support the child's developmental process.<sup>4,5</sup> Moreover, the panel defined a child as being ready for school using a set of developmentally oriented principles, encompassing the following domains: physical and motor development, cognitive development and approaches to learning, language development, and social emotional development. This big change in how school readiness was defined shifted the focus from the school house door, where school readiness was often a label of exclusion, to third trimester of pregnancy where school readiness is understood as an important outcome, determined by a set of interdependent health and developmental trajectories.<sup>6</sup> Now school readiness is not only driving educational policy but is increasingly being used by many different early childhood community-based efforts as an important measure of performance and success. That is why we think that pediatricians will increasingly find themselves needing to focus more of their attention and efforts on school readiness.

Several recent reports and surveys have suggested that pediatric practices are not doing all that they should to provide the level of developmental services that are necessary to promote optimal development and school readiness.<sup>7-9</sup> Surveys of parents have documented that many children are not receiv-

ing routine developmental assessments which can detect developmental disabilities, and that many parents are not receiving the guidance and counseling they desire about common developmental issues such as early literacy, discipline, and toilet training.<sup>10,11</sup> Other surveys of pediatricians have highlighted the numerous barriers that they report to providing such services. These barriers range from inadequate training and unfamiliarity with state-of-the-art assessment procedures, to problems with inadequate reimbursement, and a lack of community-based services to refer children and families in need of additional services and support.<sup>6,12</sup>

The study by Silverstein and colleagues<sup>13</sup> in this month's issue of *Pediatrics* provides additional and important information about the disconnection between pediatric practice and Head Start—the only national program designed to promote the development and school readiness of young children from disadvantaged backgrounds. The article also suggests what might be done to improve the connections between pediatric practices and this important community-based program. Silverstein and colleagues<sup>13</sup> report that only 36% of responding pediatricians agreed that assisting families with Head Start enrollment was the pediatrician's responsibility, and only 14% reported actually assisting families in applying to Head Start. Only half of pediatricians were aware that Head Start serves children birth to 5, and only a quarter were aware of eligibility criteria. The disconnection between evidence of effectiveness for Head Start improving low-income children's ability to achieve in elementary school<sup>14</sup> and low involvement by pediatric practices should be an important impetus for change and improvement. Similar to what has been found in other studies, there are no fiscal incentives for pediatricians to actively make connections to Head Start.

Despite the presence of these issues, there are also opportunities. There exists a small, but growing number of evidence-based methods to enhance a pediatrician's ability to provide targeted developmental promotion services.<sup>7</sup> For example, Reach Out and Read is a physician-based strategy of providing developmentally appropriate advice and modeling of book sharing as well as giving books to children and parents to take home. This relatively simple, inexpensive and low-tech intervention has been shown to increase low income children's language development by nearly 6 months for a 2-year-old, which has the potential to significantly contribute to their school readiness.<sup>15</sup>

No one argues the importance of education in determining a child's future income and hopefully their enjoyment of life; but most private and some public payers of health care often exclude payment for developmentally focused prevention and promotion services. These services are often deemed as not reimbursable. The plethora of new scientific information on brain development and early interventions further strengthens the connection between health and education. This research should be used to inform the clinical practices of promoting school readiness as well as justify payment for services. Given

the increasing body of literature that documents the modifiable factors that influence brain development,<sup>16</sup> it would seem logical that health care practices targeted at promoting brain development should be reimbursed in a way that is similar to promoting healthy functioning of other organs such as the lungs, heart, skin, etc.

The connections between child development, school readiness, education attainment, and health are also becoming clear. Poor school performance is linked to poor health behaviors—including unprotected sex, cigarette smoking, drug and alcohol use, and violence—among adolescents, behaviors that are associated with almost half of adult health problems.<sup>17,18</sup> Education level is a significant contributor to many adult causes of mortality and onset and duration of disability among the elderly. Individuals with higher educational attainment not only live longer but have a shorter duration of disability before death compared with individuals with lower educational attainment.<sup>19</sup> It is no longer logical nor socially prudent that many developmentally focused services are not covered in the same way that services to treat brain deterioration are covered.

As part of a community-based developmental health service system, pediatricians and others need to identify and refer children to appropriate interventions in a timely fashion; whether it's income-eligible children to Head Start, or children at biological risk attributable to prematurity and/or identified by developmental screening to early intervention. The good news is that there is bipartisan interest in Congress, in large part because of advocacy efforts of parents of children with Autism Spectrum Disorders, to recommend support for developmental screening using appropriate screening and surveillance instruments at selective pediatric visits. Although better payment for assessing and referring children with developmental conditions for appropriate interventions is a necessary reform, to remove the barrier of time and inadequate reimbursement, there is also the well-recognized need to improve the communication and coordination among different early childhood services, programs, and providers.

As is suggested by the article by Silverstein and colleagues,<sup>13</sup> if pediatric practice is to strengthen its focus on school readiness, it will have to go beyond improving the content and quality of care provided, by developing better and more systematic connections with other early childhood service providers. Emergency medical services (EMS) is a model of a coordinated and integrated system that developmental services could emulate. EMS has many different components but functions like a system; each component has a specific role with occasional overlapping functioning, protocols for transition among components with timely and coordinated information flow and communication. Services such as child care, Head Start, early intervention, pediatric care, and family support are available in most communities, but this availability does not define a system of care.

If pediatrics is to strengthen its emphasis on school readiness, it will require the financial incentives to

make such practices feasible. Services promoting child development will need to be designated medically necessary by payers to ensure payment and to provide the fiscal incentives that are currently lacking. Effective early childhood practices that promote school readiness, such as referral to early intervention for premature infants, Head Start, center-based child care for low-income children, developmental screening, and Reach Out and Read should all be part of a package of developmental services that are considered as necessary as other medical interventions. The good news from Silverstein's article<sup>13</sup> is that 77% of pediatricians were willing to participate in a potential office-based intervention to assist in Head Start enrollment, thereby initiating an important step to developing a system of developmental services. These services should provide a seamless interface for both families and service providers, similar to EMS. Pediatricians have an important role to play in such a developmental services system, and in providing and connecting families to services and practices that promote school readiness leading to school success.

The growing body of evidence suggests that developmental services have the potential to optimize the developmental trajectories of many children, leading not only to school readiness but to better adult health and lower long-term health care costs. Health care payment mechanisms need to adapt their reimbursement practices to be more responsive to this life course perspective,<sup>20</sup> although these interventions occur in early childhood, focus on school readiness, result in better school achievement, and only return the investment to the health care system in reduced disability 60 years later.

BARRY ZUCKERMAN, MD  
Department of Pediatrics  
Boston University School of Medicine/Boston Medical Center  
Boston, MA 02118

NEAL HALFON, MD, MPH  
Department Pediatrics  
School of Medicine  
University of California, Los Angeles  
Los Angeles, CA 90095

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## NEONATAL SMARTS

“Newborns who had diabetic mothers and were exposed to repeated heel lances in the first 24–36 hours of life learned to anticipate pain and exhibited more intense pain responses during venipuncture than normal infants.”

Taddio A, Shah V, Gilbert-MacLeod C, Katz J. Conditioning and hyperalgesia in newborns exposed to repeated heel lances. *JAMA*. 2002;288:857–861

Submitted by Student