KU develops special pacifier to help prevent infant brain injuries

LAWRENCE -- Most potential brain injuries in newborns go undetected until developmental problems begin to surface, sometime between the child's first and second birthdays.

By then, the problem may be deeply rooted in the child's nervous system, making it difficult to correct through conventional behavioral therapies.

A special pacifier being developed at the University of Kansas will change that.

A team of researchers at KU led by Steven Barlow, chair of speech language and hearing and director of the Communication Neuroscience Laboratories, in collaboration with Don Finan at the University of Colorado, has developed the Actifier -- a high-tech pacifier that helps improve a newborn baby's ability to perform essential motor skills, such as sucking in relation to swallowing and breathing.

Barlow, who also is a professor of neuroscience and human biology, describes the Actifier as a "cribside laboratory." The instrument consists of a pacifier attached to a frame about the size of an infant's shoebox. The wiring in the frame connects to a high-speed computer that gives real-time analysis of the baby's oral motor skills.

But the Actifier is more than just a diagnostic tool. After analyzing the baby's mouth and surrounding facial muscles, the eight tiny electrodes on the pacifier's shield sample electrical activity from key muscles surrounding the mouth in response to gentle stimulation.

"Those muscles have direct connections to the brain stem, which has connections to higher structures, like the cerebral hemisphere," Barlow said.

The stimulation of these facial muscles occurs in the form of an extremely brief and light tap from one of the motors integrated into the pacifier shield.

The tapping is so light and fast that most adults would not notice it with the naked eye, Barlow said.

"It would be analogous to touching the surface of your lip with a Q-tip swab, except the amount of displacement is so small you can't see it," he said.

This important stimulation jump-starts the baby's ability to fire his or her own neurons, opening damaged or poorly developed pathways in the baby's brain that trigger functions such as sucking and swallowing. The entire process lasts about 90 seconds.

"This will in turn cause populations or sub-populations of neurons in the developing nervous system to fire together," Barlow said. "We know that the neurons that fire together, wire together."

If these neurons don't fire together, it can cause serious long-term problems for the child in terms of organizing and mapping his or her perceptual world, ranging from respiratory complications to learning and speech and language disorders, he said.

Recently, the project received a boost from the National Institutes of Health in the form of a five-year, $2 million grant. The grant will enable the researchers to test the Actifier on the newborns who could benefit the most from the instrument: premature babies.

Some 390 premature babies -- born up to three months premature -- will receive the Actifier in the Neonatal Intensive Care Units at the KU Medical Center in Kansas City, Kan., and Stormont-Vail HealthCare Hospital in Topeka. Once these babies graduate from intensive care, they will continue participating in the study, using the Actifier for up to two years in the Communication Neuroscience labs on the KU campus.

Barlow said the doctors and pediatric nurses who have already worked with the Actifier prototype are impressed because the instrument is fast and noninvasive. A single grounded electrode is attached to the baby's shin or ankle, usually about 15 minutes before the baby is to be fed.

If all goes as planned, Barlow said, the Actifier could be as commonplace in neonatal wards as the stethoscope within this decade. That certainly would be a remarkable accomplishment, especially because critics often told Barlow he was wasting his time trying to get accurate neurophysiological readings from such young patients.

"In the early 1990s we were told you can't do it -- it's technologically beyond anyone's capability to record from an infant 6 months or a year of age, and we solved that one by the middle of 1993," he said. "The real challenge was making the application to the premature infant -- to get at the source of some of these developmental problems and also to stimulate the brain when it's really ripe for being changed."

Barlow, who brought his research from Indiana University to KU almost two years ago, has helped build the state-of-the art Communication Neuroscience Laboratories at KU. The $1 million facility, which opened last fall, will host the Actifier project and future engineering developments.

"One of the primary reasons I came to Kansas was that the infrastructure for developmental neuroscience is really second to none," he said. "I think the University of Kansas is probably in the best position of any major research university right now to make these types of ground breaking strides."

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