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HEALTH CARE

The New, Improved World of Infant Care

A host of high-tech advances are giving newborns a better shot at avoiding a range of ailments. The long-term impact could be profound.



Six research centers are trying to identify the causes of premature birth, which can cause serious and costly disabilities. PHOTO: JUSTIN METZ FOR THE WALL STREET JOURNAL

By Laura Landro

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A wave of innovation in newborn care is giving infants a better start in life—and could improve Americans' health far into the future.

These advances cover a range of conditions and treatments. Maternal- and fetal-medicine specialists are finding new ways to prevent premature birth, which affects one in 10 infants and can cause serious and costly mental and physical disabilities. In the neonatal intensive-care unit, doctors are adopting new procedures, devices and techniques to diagnose and treat complications that can harm future development.

At the same time, researchers are gaining new insights into genetic and environmental influences on the fetus, such as a mother's obesity or exposure to toxic substances. And a growing movement to provide better postpartum care aims to help all new mothers better care for themselves—and thus their babies.

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All of which may not only improve health during pregnancy and infancy, but for years to come. “Research on pregnant women and children is informing our understanding of adult diseases,” says David K. Stevenson, co-director of the Child Health Research Institute at Stanford University. “If we can make interventions early in life before people are burdened by chronic disease and the diseases of aging, we could have a profound impact on public health and set the stage for much greater savings later on.”

Here’s a closer look at some of the research and

innovations taking place in infant care.

Preventing preterm birth

The leading cause of infant death is preterm birth, and those who survive face serious challenges. Premature infants are more likely to suffer from obesity, high blood pressure, heart disease and stroke later in life, especially if they are very preterm, born at 28 to 32 weeks.

With funding from the March of Dimes, six prematurity research centers, including one at Stanford, are trying to identify the causes of premature birth and find ways to prevent it.

One problem is that the best available tests to predict premature birth generally work only for women at highest risk—such as those who have already had a preterm birth—and are correct only about 20% of the time. In June, researchers led by a team at Stanford reported that a new blood test for pregnant women can detect with 75% to 80% accuracy whether a baby will be born prematurely. The technique can also be used to estimate the actual amount of time the baby has been in the womb—and thus the mother’s due date—as reliably and less expensively than ultrasound, which the researchers say can be inaccurate during the second and third trimesters.

The new blood test identifies which genes in the mother, placenta and fetus give reliable signals about gestational age and prematurity risk. According to the researchers, a handful of genes are highly predictive of which women are at risk.

During pregnancy, the mother’s immune system engages in a balancing act to maintain tolerance of the fetus while protecting her against immune threats—a so-called immune clock of pregnancy in women who deliver babies at full term. With the new test, “as pregnancy progresses, if there is a disruption in the clock, we can see it in the cells,” and may be able to develop preventive measures down the road, says Dr. Stevenson, principal investigator of the Stanford prematurity research center.

Rates of premature birth—defined as delivery at less than 37 weeks’ gestation—declined from 2007 to 2014, but increased for the second consecutive year in 2016, according to the Centers for Disease Control and Prevention. While the reason is unclear, researchers are studying the role of environment, prenatal care and genetic issues. For example, studies at Stanford have found associations between very preterm birth and exposure to air pollutants during the end of pregnancy, and researchers there are now investigating a potential link between residential proximity to agricultural pesticides and preterm-birth risk.

While it may not be feasible to expect mothers to move away from communities where they are exposed to such risks, “we can focus on what we can do protect them if they have to live there,” Dr. Stevenson says.

Reducing risks to the infant brain

During delivery, even full-term babies can face the risk of brain injury if oxygen and blood supply are compromised. A lack of oxygen can cause seizures, and infants with brain injury can go on to develop cerebral palsy and developmental problems, issues that have been reduced somewhat by a treatment called therapeutic hypothermia or brain cooling. For infants born prematurely, when the brain isn’t fully developed, the risk of long-term problems from brain injury may be even greater.

Researchers are seeking ways to detect such injuries early and develop treatments and strategies to prevent and reduce subsequent disabilities. At the same time, they are learning more about how a baby’s early experiences—such as exposure to a mother’s voice, skin-to-skin contact, the room environment and painful experiences like the needles used



The new Embrace MRI system for infants at Brigham and Women’s Hospital in Boston makes it easier to monitor brain development. It has a temperature-controlled incubator to minimize the baby’s movement and makes a fraction of the noise of ordinary MRI machines. PHOTO: EASTSIDE STUDIO



Terrie Inder's team at Brigham and Women's in Boston is seeking ways to prevent or minimize brain injury. PHOTO: STU ROSNER

to place an IV—might affect brain development. “It’s not just brain injury, but the experience of the baby in the NICU and the amount of infant stress that cause deviation and disturbance in brain development,” says Terrie Inder, chair of the department of pediatric newborn medicine at Brigham and Women’s Hospital in Boston.

In a newly expanded NICU at Brigham and Women’s, the hospital recently installed the Embrace neonatal MRI, a system designed specifically for the NICU and approved by the Food and Drug Administration earlier this year. Dr. Inder says it will let researchers track how infants’ brains are developing, assess whether brain injury has occurred and guide which treatments may help prevent disability.

Studies have shown that magnetic resonance imaging can assess growth in an infant’s brain and potentially identify early deviations in brain development. But moving infants outside the NICU to a standard MRI can be hazardous to their health; the Embrace MRI is designed specifically for babies and is small enough to be installed in the NICU. It has a temperature-controlled incubator placed directly in the system that keeps the baby warm and comfortable,

and a smaller entry tube, minimizing the movement of the baby, and making it easy to very quickly remove the baby if necessary.

Brigham and Women's will use the MRI and other monitoring equipment to study the effects of a range of medical and environmental factors on the early brain behavioral development of very preterm infants, studying them along with a comparison group of full-term infants in the well-baby nursery. A sensor similar to a lie detector, worn on the infant's leg, will help measure infant responses to procedures such as diaper changes, feedings and blood tests, to identify "what makes babies happy and what is causing them distress," Dr. Inder says.

Studying infant genomes

A blood test known as the "heel stick" for newborns screens for about 30 conditions that can have an immediate impact on a baby's health, such as galactosemia, which causes problems digesting a sugar found in milk. But with funding from the National Institutes of Health, researchers at Brigham and Women's, Boston Children's Hospital and Massachusetts General Hospital are investigating a more extensive screening: genome sequencing, which examines large numbers of genes within the DNA of these infants. The study, called the BabySeq Project, is exploring how to analyze and present this information, and tracking how parents and doctors will understand and use it.

The project recently completed the first phase of enrollment, recruiting and enrolling 325 families and randomizing them to receive sequencing or usual care. Families of infants who will receive sequencing learned the results and will remain in contact with the study team for the first year of the baby's life; they may be asked to fill out surveys about how the results play a role until the child is 18.

Results will be shared with primary-care providers, and families and providers will be surveyed about how the results affect the baby's medical care and how participation has affected stress or family relationships. "Sequencing at birth could provide a template—a book of life, if you will—to predict conditions or decide what medications to use for an entire lifetime," says Robert Green, a medical geneticist at Brigham and Women's and professor at Harvard Medical School who is coleading the study.

In addition, parents have been told when their infant carries a change in DNA that confers risk for any of several thousand childhood-onset diseases caused by a single gene, whether the disease is treatable or not.

Dr. Green notes that "it has been extremely controversial to sequence healthy babies because no one knows what you will find" or how it might trigger unnecessary testing, interfere with parent-child bonding or create uncertainty and distress for parents. Concerns about privacy of the results, which are included in a child's medical records, as well as potential insurance discrimination, have been barriers to some families who declined to participate.

Researchers are also investigating the role of epigenetics—external modifications to DNA that switch genes on and off—in the inheritance of traits such as obesity. In the U.S., more than 60% of women are overweight at conception and more than one-third are obese, and studies suggest that could predispose their infants to obesity, heart disease and diabetes later in life. They're studying whether weight-control genes could be switched from obese to lean by supplementing diet, minimizing stress or using drug therapies.

While there is not much that can be done to alter the course in the womb at present, says Stanford's Dr. Stevenson, "we may be able to affect the epigenome after the baby has been born by addressing things like diet and exercise, and change the trajectory for the child for the other conditions that go along with obesity."

A low-tech breathing aid

After a baby is delivered, more hospitals are delaying cutting the umbilical cord for up to a minute—a practice known as delayed cord clamping, which provides extra blood and nutrients from the placenta before detaching infant from mother.

However, each year about 10 million babies are born not breathing, and six million of those need to be resuscitated. In those cases, the cord is cut right away and the babies handed off to a special resuscitation team. But animal studies have shown that clamping the cord before a baby breathes can cause the heartbeat to slow and decrease the amount of blood being pumped out of the heart each minute.

Obstetricians are now testing whether there is any benefit to providing extra blood from the placenta at the time of delivery to nonbreathing infants. With funding from the federal Eunice Kennedy Shriver National Institute of Child Health and Human Development, researchers led by a team at Sharp Mary Birch Hospital in San Diego are investigating whether they can reduce NICU admissions and later developmental problems by using a technique called umbilical-cord milking on babies who are not breathing.

According to Anup Katheria, lead researcher on the study and director of the neonatal research institute at Sharp, umbilical-cord milking will be used for full- and near-term infants who are born needing resuscitation at birth. Delivery teams will leave the cord intact and squeeze the cord quickly "like a tube of toothpaste" four times toward the baby, without delaying resuscitation procedures, he says. "That blood is full of billions of stem cells the baby will have for the rest of their lives, so why not give them the extra cord blood when they need it most?" In addition, he adds, it is a low-tech, low-cost solution that could help infants world-wide.

Another concern is the risks of umbilical catheters that are commonly inserted through exposed blood vessels to provide medication to newborns. The catheters, most commonly secured with nonsterile tape, are well-known culprits for bloodstream infections, which studies show can contribute to poor growth and impaired brain development and greatly increase



Anup Katheria's team at Sharp Mary Birch Hospital San Diego is trying a technique called umbilical-cord milking on babies who are born not breathing and have to be resuscitated. PHOTO: SHARP HEALTHCARE

hospital stays and costs for infants.

Hospitals have adopted rigorous protocols to reduce such infections, and researchers continue to look for prevention strategies. Novonate, a company launched from Stanford's Biodesign program, is expecting FDA approval soon for the Life Bubble, a dome-shaped semirigid device that secures the catheter against the baby's skin and protects the site from movement or touch that can transfer bacteria.

The device has been designed for both premature infants and full-term babies with medical issues that require a catheter, according to James Wall, a pediatric surgeon and assistant director of the Stanford Biodesign Innovation Fellowship.

Surgeons are also developing new procedures to treat conditions infants are born with, such as an esophagus or intestines that don't work properly. In short-bowel syndrome, for example, inadequate bowel length makes it hard to absorb nutrients, so children can't eat properly, are at risk for infection, and may eventually require small bowel and liver transplants.

Recent research has focused on lengthening existing bowels with tissue-expanding techniques similar to those used for breast implants. James Dunn, a pediatric general surgeon at Stanford and surgeon in chief at the Stanford-affiliated Lucile Packard Children's Hospital, is developing a biodegradable coil that stretches the intestine and then breaks down within the body after a couple of months. In animal models, the approach doubled the length of the intestine in two weeks.

“The idea of applying force to grow the intestine is based on many other things that we do in surgery,” says Dr. Dunn.

Improving postpartum care

Maternal-health experts have developed the concept of the “fourth trimester” to describe the weeks following birth, a critical period for a mother and infant that can set the stage for long-term health and well-being.

In May, a presidential task force overseen by the American College of Obstetricians and Gynecologists recommended a number of improvements in postpartum care, saying the current system leaves many women to navigate physical and emotional challenges on their own until the traditional postpartum visit as many as six weeks after delivery—and as many as 40% of women don't attend those.

Part of the problem is that the visits don't cover many issues women need help with, including emotional well-being, physical complications from giving birth, exercise, nutrition, sleep and fatigue. They also may fail to provide counseling on breast-feeding concerns or assess a mother's comfort and confidence in caring for the newborn.

“These visits aren't providing value,” says task-force co-chair Alison Stuebe, associate professor of obstetrics and gynecology at the University of North Carolina School of Medicine. “A patient comes in, and the doctor may say it's OK to have sex again, but that's not necessarily all women want to hear about.”

The task force recommends reimbursement policies that cover postpartum care as a continuing process rather than an isolated visit. New mothers should have an assessment within the first three weeks after birth and ongoing care as needed, concluding with a comprehensive well-woman visit, covering physical, social and psychological issues, not later than 12 weeks postpartum.

More broadly, the task force says provisions for paid parental leave are essential to enable women to recover after birth and nurture their infants. During the first few months of newborns' lives, the researchers say, they require intense, womblike nurturing. Viewing the mother and infant as a mutually dependent unit—and supporting the mother's needs more

effectively—may be one of the most important factors in ensuring newborns get the care and development they need.

“The U.S. is the only high-income country without paid maternity leave, and among employed women, almost one in four return to work within two weeks after giving birth, long before they have recovered from childbirth,” Dr. Stuebe says.

Some companies are offering new parents an app with text-messaging services to help navigate pregnancy, breast-feeding, sleep and returning to work, and academic medical centers have created apps to gather data from women who are suffering from postpartum depression and link them to help if need be. Researchers also plan to gather DNA samples to identify any genetic differences in women who suffered postpartum depression.

A University of North Carolina 4th Trimester project is also developing a new online hub offering a website and other resources for postpartum support with funding from the Global Health Foundation. “While much attention is given to pregnancy and childbirth, there is limited information for new mothers as they navigate the physical, emotional, financial and relational changes that happen after having a baby,” says Sarah Verbiest, director of the Jordan Institute for Families at UNC.

Ms. Landro, a former Wall Street Journal assistant managing editor, is the author of “Survivor: Taking Control of Your Fight Against Cancer.” Email reports@wsj.com.

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