HSC News

USC University of Southern California

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Douglas Morino

The pagers light up and gently vibrate to notify patients when their clinician is ready to see them.

Pagers give patients freedom to roam

By Douglas Morino

USC Norris Comprehensive Cancer Center is using technology to give patients more freedom and comfort as they wait for appointments.

Clinic 5, which serves urology, hematology and medical oncology patients, recently introduced square pagers similar to the devices handed out to diners waiting for a table at restaurants. Controlled by a staff member from a computer, the pagers light up and gently vibrate to notify patients when their clinician is ready to see them.

"It's about having more freedom, more comfort and really enhancing the patient experience," said Charlene Martinez, project manager in Hospital Administration.

A pilot program began Feb. 10, and the pagers are expected to be in use across USC Norris Cancer Hospital by the end of March. It is modeled after a similar program that began in the Gold Lobby of Keck Hospital in November 2013. "We took the existing system in place and tailored it to fit our needs," Martinez said.

The pagers feature small screens for custom messages typed by a staff member and sent through a web-based application accessible through an internal network. Messages can be composed in English and Spanish.

After each use, the pagers are carefully sanitized with a sani-cloth, a disposable germicidal wipe.

The pagers allow patients to roam from the hospital's traditional waiting areas to the Rainbow Café and outdoor coffee stations, the Harry and Celesta Pappas Quad, Plaza Marketplace and the Jennifer Diamond Cancer Resource Library. The pagers also reduce noise and address HIPAA concerns because hospital staff no longer have to loudly call out patient names.

An interdisciplinary team of USC Norris staff members worked on the program for the past year. About 100 pagers have been purchased. Some patients were initially wary, but most have responded with excitement, appreciating the effort to make visits as comfortable as possible.

"We've received so much great feedback," Martinez said. "Patients have really taken to it."

Cleaner air, healthier kids

By Carl Marziali

A 20-year study by Keck Medicine of USC scientists has found that millennial children in Southern California breathe easier than ones who came of age in the `90s.

The gains in lung function paralleled improving air quality in the communities studied — and across the L.A. basin — as policies to fight pollution have taken hold.

The research appeared in the March 5 issue of the *New England Journal of Medicine*.

Many studies have measured the health effects of pollution by comparing locations with different air quality. The challenge lies in ruling out other factors that may account for health differences between communities.

By following more than 2,000 children in the same locations over two decades and adjusting for age, gender, ethnicity, height, respiratory illness and other variations, the study provides stronger evidence that improved air quality by itself brings health benefits — benefits that last a lifetime for children breathing cleaner air during their critical growing years.

"We saw pretty substantial improvements in lung function development in our most recent cohort of children," said lead author W. James Gauderman, PhD,

See **POLLUTION**, page 4

'Iron Dome' at USC keeps patient records secure

By Douglas Morino

Amid disclosures of data stolen from major companies, some patients may worry that their private medical information is just a few illegal keystrokes away. But patient data is — quite literally — stored under lock and key at Keck Medicine of USC, and a team of security experts is constantly monitoring for unauthorized cyber-breaches.

"We have an iron dome over the USC system," said Chief Information Officer Joshua Lee, MD.

Safety and security of patient data has been a top priority at Keck since long before revelations of data breaches at companies including one of the nation's largest health insurers. Patient information is safely stored and multiple policies ensure that cyber security is never compromised, Lee said.

"Security has to be multi-dimensional," Lee said. "We create multiple layers to frustrate a potential attacker."

Patient data is stored off-site through Cerner Corporation, a firm that specializes in health-care information

See **RECORDS**, page 3

Little Leaguer is back in the game thanks to USC neurosurgeons

Photos courtesy Bennett family

Alex Coker, 10, pitches for his Little League team in Oklahoma.

By Kris Siwek

It was late September in Oklahoma, and 10-year-old Little League pitcher Alex Coker was taking the mound for the first time since brain surgery.

The sounds of the ballpark surrounded him — a fist hitting a glove, chants of "hey batter, batter," cheers from the crowd. Alex could hear all those sounds thanks to the perseverance of his mother, Susan Bennett, and the skill of his doctors at Keck Medicine of USC.

Alex's surgery just a couple of months before had involved removal of a tumor called an acoustic neuroma from his right auditory nerve. Common early symptoms include hearing loss, tinnitus (ringing in the ears) and problems with balance, said Rick A. Friedman, MD, PhD, director of the USC Acoustic Neuroma Center.

Alex Coker, right, with his parents Jared and Susan Bennett and younger brother Austin.

In Alex's case, it wasn't symptoms that led to the diagnosis. Because his biological father had been previously diagnosed with Neurofibromatosis Type 2 (NF2), Alex was at risk of inheriting the rare genetic mutation characterized by growth of noncancerous tumors in the nervous system. Alex's tumor was discovered during a precautionary

See **ALEX**, page 2

ALEX: Little Leaguer has brain surgery

Continued from page 1

MRI screening.

Bennett, a registered nurse, took Alex to his first brain scan at age 5, but she struggled to develop a concrete plan for observation of her son.

"There is very little information on the most effective way to monitor at-risk children born to a parent with NF2," she explained.

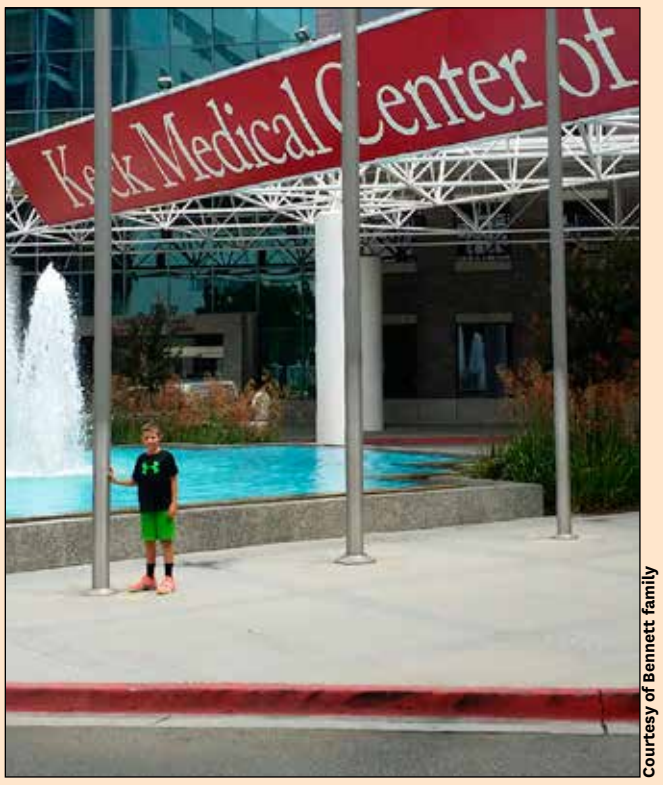
So she insisted on hearing screenings and regular visits with medical specialists in an effort to detect problems as early as possible. Soon after the MRI that revealed that Alex had an acoustic neuroma, an audiogram showed a slight high-frequency loss in his right ear.

Bennett reached out to the USC Acoustic Neuroma Center to discuss treatment options.

Friedman, a professor of otolaryngology and neurosurgery at the Keck School and division director of otology, neurotology and skull base surgery, and his colleagues recommended surgical removal of Alex's tumor as soon as possible to save his hearing for the longer term.

But Bennett and her husband Jared had received a "wait and see" recommendation from other doctors, and no parents want their child to undergo brain surgery. As they struggled with a decision that Susan Bennett recalled as heart wrenching, Alex happened to overhear.

"Mommy, I'm not scared," Bennett recalled him saying. "I want to save my hearing. I want to go to Los Angeles."



Courtesy of Bennett family

Alex Coker posed outside Keck Hospital when he was in Los Angeles for the successful surgery by USC neurosurgeons that removed tumors from his brain to save his hearing.

The surgery, a middle fossa craniotomy with microscopic excision, took place in July 2014. It was performed by Friedman and neurosurgeon Steven Giannotta, MD, chair of neurological surgery at Keck Medicine of USC.

"During the 3$^{1/2}$-hour procedure, I discovered additional tumors tangled within the patient's vestibular and facial nerves," Friedman recalled. As a result, the two surgeons had to delicately remove all the tumors, not just the one they had expected. "Although this was one of my most complex cases, we were able to remove the tumors with no postoperative hearing loss or facial weakness."

Bennett said about her reaction at the time: "I was in disbelief at the news. I was speechless. All I could say was thank you!"

Bennett hopes her family's story will empower other parents to advocate on behalf of their children and encourage them to seek a medical team they truly trust.

"The compassion that Dr. Friedman has for his patients is few and far between," Bennett said. "What he has done for Alex is amazing."

Just two days after surgery, Alex was walking again. Within two months, he was back to playing soccer, earning good grades at school and pitching a baseball.

How did Alex Coker do when he pitched his first game after surgery? No hits, no walks, plus one strikeout. Most importantly, he was able to hear his family's cheers, smile wide with pride and just get back to being a 10-year-old boy again.

Summit promotes biotech hub at HSC

By Alicia di Rado and Eddie North-Hager

Los Angeles city and county policymakers and educational institutions laid the groundwork for a biotechnology strategy at a Feb. 26 summit on the USC Health Sciences Campus.

The Los Angeles Biotech Summit drew leaders from business, academia and government to discuss ways to build the industry and, in turn, create more jobs. Panel topics included job creation through university-spawned companies, plus economic and workforce development.

"As the Great Recession decimated U.S. job growth, one sector continued to thrive: biotechnology," said USC President C. L. Max Nikias, PhD. He has called for an ecosystem in Los Angeles that fosters business, venture capital investment and access to academic medical centers for research and clinical trials. The summit sought to build momentum behind this push in Los Angeles County.

USC and other research universities in the area brought in nearly $2 billion in research dollars in 2010 — the second-highest research expenditure total for any U.S. metro region — according to an L.A. County report on biotech. But often the discoveries are turned into new drugs or devices by companies located far away.

To counter the drain of potential biotech jobs and innovation, the County Board of Supervisors unanimously voted in November to develop a biotechnology framework. As part of that effort, leaders propose building several biotech corridors across Los Angeles County.

Thomas S. Sayles, JD, USC's senior vice president for university relations, said biotech corridors would leverage existing academic medical centers, companies and colleges to spur economic development and job creation. One such corridor would use the Health Sciences Campus as an anchor — building on the intellectual, medical and community assets of the Keck School of Medicine of USC, LAC+USC Medical Center and pharmaceutical firms.

"If we get it right, the economic potential is enormous," Nikias said. "The initial Biotechnology Park is expected to create 3,000 construction jobs and nearly 4,000 permanent positions, from entry-level technicians to high-wage doctorate-level scientists."

Nikias met with County Supervisor Hilda Solis in advance to discuss their visions for the eastside corridor and building a broad-based coalition of educators, government and investors. He estimates that the corridor would be similar to San Francisco's Mission Bay project, which will employ 30,000 people.

"All of the ingredients for Los Angeles to capture growth in this booming field are already here," Nikias said. "With the right alignment between government, academia and industry, we can harness the region's existing strengths — including our science graduates — to create lasting economic growth."

Other USC participants included Andy McMahon, PhD, provost professor and chair of the executive committee of USC Stem Cell, and Steve Kay, PhD, biochemist and dean of the USC Dornsife College of Letters, Arts and Sciences.

Calendar of Events

Friday, March 13

11 a.m. MMI Presents: The Delphine & James Fahringer Seminar Series Seminar. "Epigenetic Control of Gammaherpesvirus Latency," Paul M. Lieberman, PhD, Wistar Institute. Harlyne Norris Research Tower, LG 503/4. Info: Aileen Calimlim, (323) 442-1710, calimlim@usc.edu

Monday, March 16, plus March 19, 23 and 30

Noon or 11 p.m. Office of Emergency Management & Business Continuity Lecture. Bring Your Lunch and Learn Seminar. "Active Shooter, Remaining Prepared in a Run, Hide, Fight World," Robert C Vance III, USC. March 16, 23, noon: Norris Hospital, Room 1315; March 19, 11 p.m., and March 30 at noon: Keck Hospital Cardinal Room; March 19, noon: Soto II, Room 2102. Info: Bob Vance, (323) 442-9915, robert.vance@med.usc.edu.

Tuesday, March 17

5:30 p.m. Ophthalmology Grand Rounds. Billy Pan, MD, USC. HC4, Conference Room, 3rd Floor. Info: Tyaisha Christopher, (323) 409-5233, Tyaisha.Christopher@med.usc.edu

Wednesday, March 18

Noon. Zilkha Neurogenetic Institute Seminar. "3D Genome Organization and Gene Transcription Regulation in Human Diseases," Yijun Ruan, PhD, Jackson Laboratory for Genomic Medicine. Herklotz Seminar Room, ZNI 112. Info: Julie Carl, (323) 442-3219, jcarl@usc.edu

Tuesday, March 24

Noon. Office of Emergency Management & Business Continuity Meeting. "HSC CERT Meeting," Jeff Pendley, USC. Valley Warehouse. Info: Robert Vance III, (323) 442-9915, robert.vance@med.usc.edu

Thursday, March 26

Noon. Southern California Research Center for ALPD & Cirrhosis Lecture. "Mitochondria and Metabolic Regulation of Human Pluripotent Stem Cell Differentiation," Michael Teitell, UCLA. McKibben Lecture Hall, 156. Info: Julie Lee, (323) 442-4844, julie.lee@med.usc.edu

Friday, March 27

11:45 a.m. Center for Applied Molecular Medicine Seminar. "Circulating Tumor Cells as Liquid Biopsies for Metastasis," Min Yu, MD, PhD, USC. Harkness Auditorium. Info: Rosa Rangel, (310) 936-0610, rmrangel@usc.edu

Wednesday, April 1

4:30 p.m. KSOM of USC, Department of Anesthesiology Lecture. "5th Annual Vladimir Zelman Distinguished and Endowed Lectureship," Yevgeny Yevtushenko and James Ragan. Aresty Auditorium. Info: Renee Meadows, (323) 409-6856, rmeadows@usc.edu. Reception, 4:30; lecture, 5:15 p.m.

Thursday, April 02

Noon. Southern California Research Center for ALPD & Cirrhosis Lecture. "Catenin Signaling in Liver Pathophysiology: Implications in Regeneration and Cancer," Satdarshan (Paul) Singh Monga, University of Pittsburgh. McKibben Lecture Hall, 156. Info: Julie Lee, (323) 442-4844, julie.lee@med.usc.edu

4:30 p.m. Jane Anne Nohl Division of Hematology and Center for the Study of Blood Diseases Lecture. "The 2015 Donald I. Feinstein Distinguished Lectureship: A Unifying Theory of Thrombus Formation," Bruce Furie, MD, Harvard Medical School. NTT 7409. Info: Cathy Bergren, (323) 865-3913, cbergren@usc.edu

Friday, April 3

Noon. Jane Anne Nohl Division of Hematology and Center for the Study of Blood Diseases Lecture. "The 2015 Donald I. Feinstein Distinguished Lectureship: Oral Anticoagulants — Old, New and Newer," Bruce Furie, MD, Harvard Medical School. LAC+USC Medical Center, Conference Room B. Info: Cathy Bergren, (323) 865-3913, cbergren@usc.edu

Tuesday, April 07

Noon – 5 p.m. Office of Student Affairs. "Medical Student Research Forum and Poster Day," KSOM. Mayer Auditorium Pappas Quad. Info: Mandy Garcia, (323) 442-3050, mandygar@usc.edu

Thursday, April 09

Noon. Southern California Research Center for ALPD & Cirrhosis Lecture. Ian Macara, Vanderbilt University Medical Center. McKibben Lecture Hall, 156. Info: Julie Lee, (323) 442-4844, julie.lee@med.usc.edu

Monday, May 18

10 a.m. USC Verdugo Hills Hospital Foundation and Keck Medical Center of USC. "Golf Classic 2015 – 24th Annual Golf Tournament," Oakmont Country Club. Info and RSVP: Deb Jordan, (818) 952-3553, deb.jordan@vhh.usc.edu, http://www.uscvhh.org/Golf-Classic-2015

Farnham Lab helps create landmark genetic roadmap

By Les Dunseith

Keck Medicine of USC researchers in the lab of Peggy Farnham, PhD, were key participants in the recent publication of a landmark collection of scientific papers related to mapping the DNA and histone modifications in human epigenomes and the ways that they coordinate the body's biological activities.

Farnham is one of the leading experts in epigenetics, a field of study that seeks to explain how genes and life experience conspire to make us who we are. The epigenome is a series of chemical annotations to our DNA and associated proteins that determines whether, how and when genes are activated. These chemical changes determine normal development of the body, and disruptions in epigenetic control are involved in disorders from cancer to autism to heart disease.

Beginning in 2008, the Roadmap Epigenome Consortium set out to identify the cell type-specific regulatory elements in a large number of different human cell types, said Farnham, who is the William M. Keck Professor of Biochemistry and Molecular Biology and associate dean for graduate affairs at the Keck School of Medicine of USC. She has been part of the consortium since its inception.

The research, a culmination of years of work by hundreds of participants, was published online Feb. 18 by the journal *Nature* and six other journals under the aegis of Nature Publishing Group.

Van Urfalian

Peggy Farnham and her lab contributed to four of the 22 papers published Feb. 18 in the epigenome package.

In all, the consortium of scientists simultaneously published 22 papers that represent the first comprehensive maps and analyses of the epigenomes of a wide array of human cell and tissue types. Farnham and her lab took part in a large integrative paper that was central to the project, plus additional papers in the set.

A unique contribution of Farnham's lab was a paper that focuses on deleting a regulatory element to expand our knowledge of how genomic variation contributes to the risk of colon cancer. Follow-up efforts will expand the analyses to prostate cancer.

She said that publication of the epigenome mapping project has great significance in our understanding of how the epigenome modifies the genome, making marks that tell genes what to do and when to do it.

"One of the surprising findings that came from genome sequencing is that humans have about the same number of protein-coding genes as a microscopic worm," Farnham said about prior research that formed the foundation upon which epigenome research is based.

"Only a small fraction of the human genome encodes proteins, suggesting that the large differences between our development and that of other, less complicated organisms is likely due to precise changes in the abundance of specific proteins, which is in turn controlled by regulatory elements that can be switched from inactive to active states," she continued.

Unlike genes, which remain fairly stable during an individual's lifetime, the epigenome is dynamic. Researchers are finding that the epigenome's instructions can be altered by personal habits such as smoking or eating fatty foods. It also changes in response to experiences such as prolonged severe stress. Understanding why this happens is vital to the battle against disease.

"Understanding how genomic sequence elements regulate normal development and differentiation — and how variants in the genome contribute to human diseases such as colon cancer — are leading challenges of 21st Century medicine," Farnham said.

Publication of the research was an undertaking in itself. More than a year ago, the consortium approached *Nature* to propose publication of papers that represented the culmination of the Roadmap Epigenome Mapping Project.

"Nature said they were willing to consider publication of a large set of papers," Farnham said, "and everyone sent abstracts of their individual papers. Then the various Nature journals decided if they were interested in reviewing any of them."

Papers that made the first cut then went through the journals' normal editorial scrutiny process. "Not all of the submitted papers were accepted," Farnham said. "The final 22 are the ones that made it the whole way."

In all, Farnham and members of her lab took part in four of the 22 papers that were part of the Feb 18 package. Their paper that focused on colon cancer was published in *Nature Communications*. Farnham said that all the research described in that paper was performed here at USC.

The Farnham Lab is situated at USC Norris Comprehensive Cancer Center. Additional USC participants in the epigenome research were Research Specialist Heather Witt, PhD candidate Lijing Yao, PhD candidate Yu Gyoung Tak and Benjamin Berman, who at that time was an assistant professor in the Department of Preventive Medicine at the Keck School of Medicine of USC.

New protein target is found for prostate cancer treatment

By Leslie Ridgeway

Keck Medicine of USC scientists have found a promising new therapeutic target for prostate cancer.

The findings offer evidence that a newly discovered member of a family of cell surface proteins called G-protein coupled receptors (GPCRs) promotes prostate cancer cell growth. The protein, GPR158, was found while the researchers were looking for new drug targets for glaucoma.

"When a prostate cancer tumor is in its early stages, it depends on hormones called androgens to grow," said Nitin Patel, PhD, research scientist at the Institute for Genetic Medicine at the Keck School of Medicine of USC, and corresponding author on the research. "Eventually it progresses to a more lethal form, called castration-resistant prostate cancer (CRPC), and is resistant to drugs that block androgen receptors. We found that GPR158, unlike other members of the GPCR family, is stimulated by androgens, which in turn stimulates androgen receptor expression, leading to tumor growth."

The researchers used a conditional Pten knockout mouse model of prostate cancer in collaboration with Keck School researchers Mitchell Gross, Chun-Peng Liao and Pradip Roy-Burman.

The study was published Feb. 18 in the journal *PLOS ONE*.

The research was produced by the laboratory led by senior author M. Elizabeth Fini, PhD. Other USC research contributors include Tatsuo Itakura, Shinwu Jeong, Ebrahim Zandi, Susan Groshen, Jacek Pinski and Gerhard A. Coetzee.

Virginia Baca

HERO OF YOUR OWN HEALTH STORY — Two physician faculty leaders from Keck Medicine of USC presented their script for living longer and living better on March 5 at the 2015 USC Women's Conference. Leslie Saxon, MD, professor of medicine and clinical scholar, and colleague Laura Mosqueda, MD, chair of Family Medicine, provided advice on optimal aging. "Exercise is the most important thing you can do for brain health," Mosqueda advised.

RECORDS: Cyber-security measures protect patient data

Continued from page 1

technology. This physical storage facility is secured, but a separate data security firm and USC staff members also protect electronic data through other measures.

Among them is a security operations center in which electronic information is monitored around-the-clock by security professionals looking for abnormal computer traffic, malware and network intrusions.

Stored patient data may include clinical records, medication, length of stay and billing records. Should an unauthorized data breach still occur, patients would be immediately notified, as would state and federal officials.

Hackers target personal data because it can be sold on the underground market.

After recent data breaches at major health insurers, officials have been investigating the extent of the cyber attack, and state and federal officials are probing whether the companies took proper measures to secure data.

At Keck Medicine of USC, the storage system also uses various authentication measures to prevent breaches, including requiring that users gain access into the system through strong passwords that can't be easily deciphered by hackers.

Keck staff members are also looking at two-factor authentication, which might require a thumbprint, a retina scan or an electronic token that rotates to a new code every 30 seconds.

Staff members regularly evaluate new cyber threats and discuss security measures.

"We are constantly working to ensure that our electronic storage systems are up-to-date with the highest security standards," Lee said.

HSC Newsmakers

A roundup of news items related to Keck Medicine of USC, which may include philanthropic donations, research grants, publication in academic journals and mentions in the news media:

Drug reverses vision loss in people with diabetic eye disease

A PRESCRIPTION DRUG commonly used to treat age-related vision loss also reverses vision loss caused by diabetes, according to a study led by investigators from the USC Eye Institute. "We found that ranibizumab can save the sight of thousands of working-age individuals suffering from diabetic eye disease, as standard treatments such as laser are not as effective," said Rohit Varma, MD, MPH, director of the USC Eye Institute, professor and chair of ophthalmology at the Keck School of Medicine of USC and the study's lead author. Diabetic retinopathy and diabetic macular edema are the leading causes of vision loss in working-age adults in the United States. Varma's team developed a population-based model that suggests that administering 0.3 milligrams of ranibizumab every four weeks to patients with diabetic macular edema would reduce the number of cases of vision impairment by 45 percent, or 5,134 individuals, and the number of cases of legal blindness by 75 percent, or 1,275 individuals. Ranibizumab is manufactured and marketed by Genentech Inc. under the trade name Lucentis. The study published Feb. 7 in the online edition of the medical journal *Ophthalmology* was supported in part by Genentech. — **Alison Trinidad**

Varma

Heart regenerative capacity depends on severity of injury

RESEARCHERS AT CHILDREN'S HOSPITAL Los Angeles (CHLA) have shown that neonatal mouse hearts have varying regenerative capacities depending upon the severity of injury. Using cryoinjury — damaging the heart through exposure to extreme cold in order to mimic cellular injury caused by myocardial infarction — investigators found that neonatal mouse hearts can fully recover normal function following a mild injury, though they fail to regenerate after a severe injury. Published online by the journal *Developmental Biology*, the study suggests that cardiac regeneration strategies should be based on the type and severity of heart injury. "Using models such as zebrafish and neonatal mice that regenerate their hearts naturally, we can begin to identify important molecules that enhance heart repair," said Ellen Lien, PhD, of the Saban Research Institute of CHLA. Lien, who was senior author on the paper, is also an assistant professor at the Keck School of Medicine of USC and a principal investigator with USC Stem Cell. Newborn mice have shown the capacity for heart regeneration, but it is rapidly lost by seven days after birth. Approaches to extend this regenerative capacity in a mammalian model from the neonatal period to the juvenile or adult period could help identify new treatment options for humans. — **Ellin Kavanagh**

Lien

Low sugar uptake in brain appears to exacerbate Alzheimer's disease

A DEFICIENCY IN THE PROTEIN that moves glucose across the brain's protective blood-brain barrier appears to intensify the effects of Alzheimer's disease, according to a study from the Keck School of Medicine of USC. The research suggests that targeting the protein called GLUT1 could help prevent or slow the effects of Alzheimer's, especially among those at risk for the disease. The study appeared March 2 in the online edition of the scientific journal *Nature Neuroscience*. "Our results suggest that GLUT1 deficiencies at the blood-brain barrier are not just symptoms of Alzheimer's but, in fact, lead to a series of vascular injuries that worsen the effects of the disease," said the study's principal investigator, Berislav V. Zlokovic, MD, PhD, director of the Zilkha Neurogenetic Institute at the Keck School and the Mary Hayley and Selim Zilkha Chair for Alzheimer's Disease. "We do not know yet whether medicine can restore GLUT1 expression, but we believe that targeting the protein may help prevent Alzheimer's from getting worse among individuals predisposed to develop the disease." — **Alison Trinidad**

Zlokovic

POLLUTION: Long-term study of children finds health benefits from cleaner air

Continued from page 1

professor of preventive medicine at the Keck School of Medicine of USC.

He noted that this is the first good news from the long-running study. "It's strange to be reporting positive numbers instead of negative numbers after 20 years."

Previous findings from the study that showed an increase in stunted lung development for children in areas with heavy air pollution were widely reported, as was a higher risk of asthma for children living near busy roadways. Combined exposure to two harmful pollutants, nitrogen dioxide (NO2) and particulate matter of diameter under 2.5 microns (PM2.5), fell by approximately 40 percent for the group designated as the third cohort of 2007-2011 as compared to the first cohort of 1994-98. The study followed children from Long Beach, Mira Loma, Riverside, San Dimas and Upland.

Children's lungs grew faster as air quality improved. Lung growth from ages 11 to 15 was more than 10 percent greater for children breathing the lower levels of NO2 from 2007 to 2011 compared to those breathing higher levels from 1994-1998.

The percentage of children in the study with abnormally low lung function at age 15 dropped from nearly 8 percent for the 1994-98 cohort to 6.3 percent in 1997-2001 to just 3.6 percent for children followed from 2007 to 2011.

That compares to 2.5 percent by age 18 for children from the first two cohorts who lived in cities with cleaner air, such as Lompoc and Santa Maria. Cuts in federal funding forced the researchers to exclude those cities in the last cohort and focus only on areas with heavier air pollution.

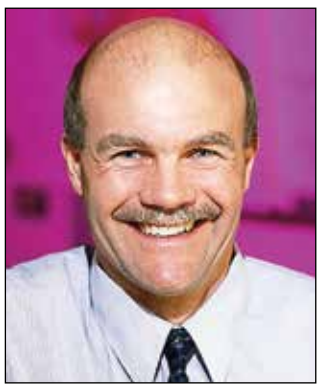
"Reduced lung function in adulthood has been strongly associated with increased risks of respiratory disease, cardiovascular disease and premature death," Gauderman said. "Improved air quality over the past 20 years has helped reduce the gap in lung health for kids inside, versus outside, the L.A. basin."

The growing years are critical for lung development. The researchers are monitoring lung function in a group of adults who participated in the study as adolescents. So far they have not found evidence of a rebound after the teenage years.

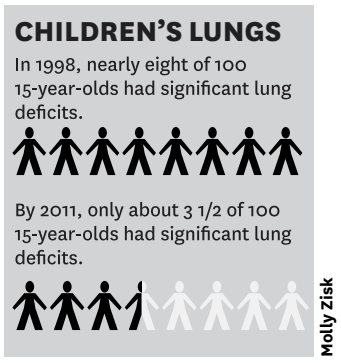
"Their lungs may have lost the opportunity to grow any more," Gauderman suggested.

Lung development measured by the study improved across the board, regardless of education, ethnicity, tobacco exposure, pet ownership and other factors.

Across all five communities, lung development for children with asthma improved roughly twice as much as for other children. But even children without asthma showed significant improvements in their lung capacity, suggesting that all kids benefit from improved air quality.



W. James Gauderman



"We expect that our results are relevant for areas outside Southern California, since the pollutants we found most strongly linked to improved health — nitrogen dioxide and particulate matter — are elevated in any urban environment," Gauderman said.

The incidence of asthma did not change significantly over the three cohorts. Previous research by the Children's Health Study showed that the risk of asthma increases with proximity to busy roadways.

Local, state and federal regulations have achieved large reductions in pollutants in the Los Angeles basin.

Visibility also has improved. Southern California locations surpassed their 2018 state goals by 2012.

"It's an environmental success story. The air has gotten much cleaner than it was in the past. I grew up here in the `70s. Even from Pasadena you couldn't see the San Gabriel Mountains on a typical summer day," Gauderman said.

Gauderman cautioned: "We can't get complacent, because not surprisingly the number of vehicles on our roads is continually increasing. Also, the activities at the ports of L.A. and Long Beach, which are our biggest polluting sources, are projected to increase. That means more trucks on the road, more trains carrying cargo."

"These gains really aren't fixed," added senior author Frank Gilliland, MD, MPH, PhD, Hastings Professor of Preventive Medicine at the Keck School. "We have to maintain the same sort of level of effort to keep the levels of air pollution down. Just because we've succeeded now doesn't mean that without continued effort we're going to succeed in the future."

Gilliland noted that the state's historic drought is expected to raise particulate pollution.

Gauderman's and Gilliland's co-authors were Robert Urman, Edward Avol, Kiros Berhane, Rob McConnell, Edward Rappaport and Roger Chang, all from the Department of Preventive Medicine at the Keck School, and Fred Lurmann of Sonoma Technology Inc.

USC Health Sciences
Public Relations and Marketing
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Editor: Les Dunseith

Director, Internal Communications: Virginia Baca

Executive Director, Creative Services: Tom DeSanto

Contributors: Sharon Brock, Tania Chatila, Cristy Lytal, Carol Matthieu, Douglas Morino, Sara Reeve, Leslie Ridgeway, Talar Shahinian, Sherri Snelling and Alison Trinidad

Phone: (323) 442-2830
Fax: (323) 442-2832
Email: hscnews@usc.edu
Web: hscnews.usc.edu | kecknet.usc.edu

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