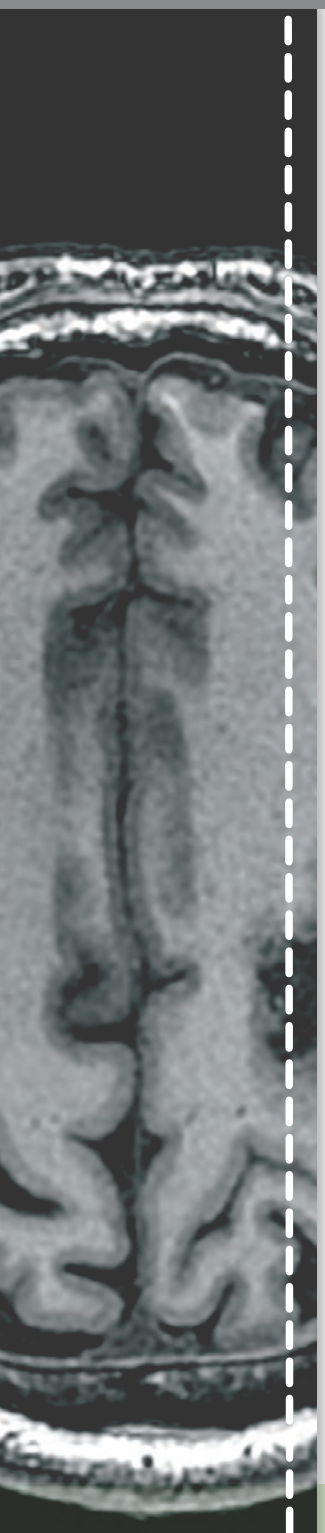
Le Bonheur Children's Hospital
Memphis, Tennessee

Brain Waves

Neuroscience Institute

Summer 2023



Pinpoint Precision

ROSA One Brain technology provides minimally invasive, more precise seizure localization

For Le Bonheur neurosurgeons, to perform a successful epilepsy surgery, they need two critical pieces of information: where a child's seizures are located and what areas of the brain to avoid to preserve function.

Enter the ROSA One Brain – a robot that provides neurosurgeons with presurgical mapping and precision instrument guidance. ROSA consists of advanced software for mapping and guidance and a robotic arm that the software directs to precise, premapped locations. ROSA fits inside of Le Bonheur's neurosurgery Operating Rooms (ORs).

ROSA One Brain's software combines patient imaging to create a 3D map of the patient's brain and head prior to surgery. With this information, neurosurgeons can precisely plan the best placement for electrodes to find seizure areas while avoiding structures critical to function.

Currently, this technology is used for stereoelectroencephalography (SEEG), a minimally invasive procedure that places a large number of electrodes deep in the brain using incisions of around 2 to 3 millimeters to insert an electrode of just 1.2 mm in diameter. No longer do neurosurgeons have to expose a patient's brain to place electrodes, and ROSA's guidance and planning abilities leads to less OR time and higher accuracy.

"When I conduct an epilepsy surgery, my goal is to find the problem and fix it," said Le Bonheur Neurosurgeon Nir Shimony, MD. "With the ROSA's capabilities, the chances of finding and fixing the seizure problem areas are much higher and much safer."

Combining ROSA with Le Bonheur's full suite of brain imaging products, which includes magnetoencephalography, functional MRI and transcranial magnetic stimulation, Le Bonheur neurosurgeons can create detailed surgery plans to remove seizure areas while also focusing on preserving language, sensory and motor function.

A PRECISE OPERATION

Because of ROSA's precise mapping and guidance, Le Bonheur neurosurgeons can reach previously inaccessible areas of the brain with electrodes in a fraction of the time and with less recovery for the patient. The result of these benefits is a better chance for neurosurgeons to identify seizure locations and create a tailored treatment plan for each child.

From a practical standpoint, SEEG with ROSA is a far easier and safer procedure for children. With its minimally invasive nature, patients can recover more quickly. Conducting a major surgery that removed the skull and exposed the brain, as was needed previously, had an increased potential to lead to bleeding, infection or other surgery complications.

"In a way, SEEG with ROSA is a completely different operation," said Shimony. "The patient wakes up like you haven't done anything neurosurgically invasive. Previously we had to open and expose the brain to place grid electrodes and

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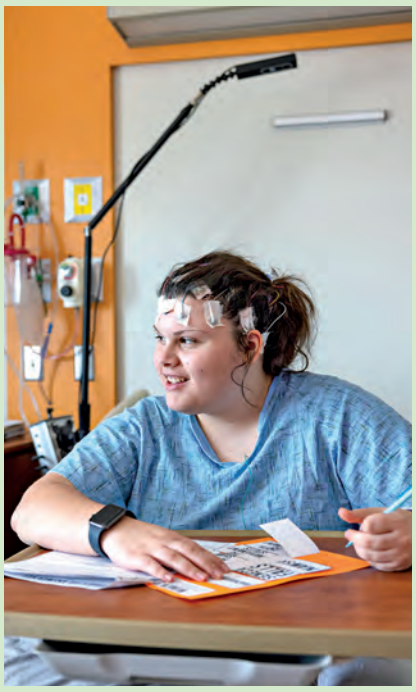
AI for Epilepsy

Le Bonheur's Neuroscience Institute participates in clinical trial to validate AI seizure detection and characterization system

If your child has seizures, something as routine as putting them to bed can be fraught with anxiety. What if the child has a seizure overnight? Should the parent sleep in the same room as their child? What if they don't hear their child having a seizure?

Neurologists at Le Bonheur Children's Hospital are working with researchers on a clinical trial to validate Nelli®, an artificial intelligence (AI) technology that has the potential to ease parental anxiety and detect a child's seizures. Le Bonheur is the first hospital in the United States to test this technology for its use with children.

"If we can validate this technology, it would provide great peace of mind to parents. If their child is not seizure free at night, they could be alerted and attend to their child in case of a seizure," said James Wheless, MD, chief neurologist and co-director of Le Bonheur's Neuroscience Institute. "One of our goals is identifying technology that can help us help families."



Le Bonheur Children's Hospital is the first location in the U.S. to test the Nelli™ seizure detection system for its use with children. Pictured here, the system is used in Le Bonheur's Epilepsy Monitoring Unit (EMU) and consists of a camera (pictured above the patient), computer and microphone.

Le Bonheur's Neuroscience Institute has long been involved in trials to examine technology that detects, diagnoses and treats seizures. The Nelli® system is just one in a long line of technologies that Le Bonheur physicians have investigated to benefit their patients.

Nelli® consists of a personal recording unit (PRU) that contains a computer, camera and microphone. The child does not wear anything, and nothing is connected to them. The PRU captures movement and sound and then analyzes them via AI algorithms to determine if they are indicative of seizures. The system uses advanced machine learning techniques to continue refining its ability to detect seizures as it learns more movements and sounds that indicate a seizure event. The system also generates a report for a physician to review their patient's seizure activity.

But the system is still learning, particularly with detecting children's seizures. That's why its creators contacted Wheless to assist with a clinical trial validating its use for children using the Epilepsy Monitoring Unit (EMU) at Le Bonheur.

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Referrals: 866-870-5570
www.lebonheur.org/neuroscience

A pediatric partner with The University of Tennessee Health Science Center/College of Medicine and St. Jude Children's Research Hospital

BEST CHILDREN'S HOSPITALS U.S.News & WORLD REPORT RANKED IN 5 SPECIALTIES 2023-2024

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then repeat the same exposure a few days later to remove the grids."

When preparing for an SEEG procedure, ROSA's assistance begins before reaching the OR. Combining MRI, CT scans and any other brain imaging from the patient, ROSA creates a comprehensive 3D map of the patient's brain and head. Using these maps and ROSA's software, neurosurgeons can create a plan for the trajectory of the electrodes so that they reach precise areas of the brain while avoiding critical structures. This advanced planning typically means less time in the OR and less time a child is under anesthesia.

Once in the OR, ROSA scans the patient's facial features with a laser and matches the scan to the 3D map of the brain and head. ROSA then guides the surgical instruments to precise locations on the skull based on the surgical plan created before surgery. With just a millimeters large incision, Shimony and his team can place the electrode deep into the brain with an error margin of less than 1 mm.

The time saved with ROSA-assisted SEEG means that neurosurgeons can place more electrodes in less time, which equals a better possibility to identify seizure focus areas. The extensive preoperative planning available with ROSA means that electrode placement accuracy is higher, as the robot guides instruments to their precisely planned locations.

How It Works: SEEG with ROSA One Brain

1. **Before surgery, neurosurgeons combine the patient's brain imaging to create a 3D map of the child's head and brain with ROSA's software.**
2. **Using this comprehensive imaging, neurosurgeons make a plan for electrode placement that reaches as much brain area as possible while avoiding critical structures for function.**
3. **In the OR, ROSA uses a laser to scan a patient's facial features and match them to the 3D map.**
4. **Using the presurgical plan, ROSA precisely guides the surgical instruments to predetermined places on the skull where electrodes will be placed.**
5. **Neurosurgeons make a millimeters small incision and place the electrode deep into the brain.**
6. **An EEG machine in the OR confirms the placement and function of each electrode.**
7. **After all electrodes are placed, the patient's head is wrapped in a bandage, and they are sent to the Epilepsy Monitoring Unit (EMU) to determine begin the process of determining seizure location.**

ROSA One Brain's software combines patient imaging to create a 3D map of the patient's brain and head prior to surgery. With this information, neurosurgeons can precisely plan the best placement for electrodes to find seizure areas while avoiding structures critical to function.

"We used to limit ourselves to four to five electrodes because it took so long and meant that patients were under anesthesia for an extended amount of time," said Shimony. "This is much easier and safer, so we have the ability to put in more electrodes, potentially finding not only where seizures are coming from, but also where they propagate to. This gives us much better options and a higher chance to have a successful solution for the patients and their families."

An EEG machine in the OR confirms the placement and function of each electrode. Once finished, the patient's head is wrapped with a bandage, and they are sent to Le Bonheur's Epilepsy Monitoring Unit (EMU).

And the process of removing the electrodes is easier, too. If not removed during epilepsy resection surgery, neurosurgeons can remove them with light sedation, closing each incision with just one stitch. With previous methods, the brain would be exposed a second time to remove the electrodes.

All of these benefits combine in an effort to reach the ultimate goal of these neurosurgeons – finding the source of seizures and helping to alleviate the epilepsy burden for patients and families, potentially even eliminating seizures completely. ROSA's technology gives the ability to pinpoint multiple targets and cover much more space in the brain. Instead of looking at just where seizures start, neurosurgeons can potentially find the extensive networks of the brain that are involved in the seizures.

"ROSA allows us to cover a lot of space in the brain with a better chance to find the problem and benefit the patient," said Shimony. "In the past, we could find the seizure area about 70% of the time. With ROSA and SEEG, we are up to 90%."

ADVANTAGE OVER EPILEPSY

This new technology fits in seamlessly with the Le Bonheur Neuroscience Institute's existing suite of brain imaging – one of the most comprehensive for a children's hospital in the country. Transcranial magnetic stimulation (TMS), magnetoencephalography (MEG) and functional MRI are all non-invasive technologies that can map the brain's language, sensory and motor centers to assist with epilepsy surgery planning to avoid these areas.

"Very few centers use all ancillary tests like Le Bonheur does," said Shimony. "We fuse the results of every test together, which allows us to have a very precise plan regarding anatomy and function of the patient when we proceed with epilepsy surgery."

While Le Bonheur currently uses ROSA for SEEG procedures, the uses for the technology will continue to grow. Le Bonheur neurosurgeons eventually hope to use ROSA for laser operations that would ablate tumors or deep structures for epilepsy, which will benefit from ROSA's precision and accuracy.

With just a millimeters wide incision, neurosurgeons are able to place electrodes deep in the brain at precisely planned locations.

Minimally invasive surgery continues to be the trend, and neurosurgeons continue to look for ways to do extensive surgeries through a small entry point, says Shimony.

"Having ROSA adds a very robust tool to our suite of technologies," said Shimony. "We can make data-driven decisions when planning a surgery and provide an easier and more effective seizure localization process for our patients."

AI for Epilepsy, continued from page 1

"We have a robust and busy EMU that captures many types of seizures," said Wheless. "We also have a track record of testing seizure detection devices for families — we understand the concept and have a history of participating in many of these trials to use technology to improve the lives of our patients and families."

To date, Le Bonheur's Neuroscience Institute has been involved in 24 studies that use technology to help children with epilepsy. Four of those studies investigated epilepsy treatments with technology, such as responsive neurostimulation (RNS) and vagus nerve stimulation (VNS), including studies to bring VNS to market for use in children. So far, Le Bonheur has conducted 11 trials to investigate technology that detects seizures.

And now Wheless and Le Bonheur's neurologists are helping Nelli® learn to better detect seizures by reviewing the results produced by the system to improve the algorithms and provide a more accurate seizure report. If a child in Le Bonheur's EMU has a seizure, but Nelli® doesn't label it as such, the video EEG system in the EMU will pick up the seizure event. Le Bonheur neurologists can mark the event as a seizure in the system's stored memory. From then on the system will register that movement or sound as associated with a seizure. In this way, Le Bonheur neurologists are determining which seizures types the AI is missing and then helping the AI to improve.

Potential Benefits of Nelli®

- **Ease parental anxiety about nighttime seizures**
- **Detect seizures without requiring the child to wear anything**
- **Constant nighttime monitoring for seizures**

The ultimate goal is to validate the system so that parents can use Nelli® at home as a seizure detection and management system. Any movements and sounds would instantly run through the database. If the movements and sounds are associated with seizure events, the system would notify in near real time. This way, parents could sleep better at night and have peace of mind knowing their child was under constant monitoring.

The system could also be valuable for neurologists as they look to best treat their patient's seizures. Neurologists could use results from the system to determine whether or not a patient is having seizures and what kind, which is helpful information to adjust treatment and alert physicians if the child's seizure control is inadequate.

"At this stage, the technology looks very promising. Nelli® could improve patient care by giving parents peace of mind. If a caregiver is exhausted — either from not sleeping at night due to a concern that their child will have a seizure or from sleeping with the child — a child is not going to get as good of care," said Wheless.

Wheless receives first Tom Horton and Donna Wiener Endowed Chair in Neuroscience

James Wheless, MD

Le Bonheur Children's Hospital's Chief of Pediatric Neurology and Co-Director of the Neuroscience Institute James Wheless, MD, was recently named the first recipient of the Tom Horton and Donna Wiener Endowed Chair in Neuroscience, thanks to a transformational gift from the Martha, Bowen and Tommy Horton Family and Joy Wiener. Their investment will support Le Bonheur's FedEx Neuroscience Institute's mission to continue delivering outstanding clinical care, teaching the next generation of physicians and advancing the science of caring for children with complex neurological disorders.

The Endowed Chair in Neuroscience carries on Le Bonheur's storied tradition as a national leader in the field of neuroscience will provide opportunities to treat patients, utilize state-of-the-art equipment and technology, conduct innovative research and ensure skilled care for generations to come.

"I am greatly honored to be the first to receive the Tom Horton and Donna Wiener Endowed Chair of Neuroscience at Le Bonheur Children's," said Wheless. "With this generous gift, our Neuroscience Institute will be equipped to not only provide excellent care for children for years to come, but also invest in innovative research and groundbreaking technology while training the next generation of physicians."

Wheless is also professor and chief of Pediatric Neurology and the Le Bonheur Chair in Pediatric Neurology at the University of Tennessee Health Science Center and serves as director of the Le Bonheur FedEx Neuroscience Institute Comprehensive Epilepsy Program. His primary interests include childhood convulsive disorders, and his research focuses on pediatric antiepileptic drug development, the ketogenic diet, epilepsy surgery, device therapy and noninvasive functional brain mapping. Wheless is the author of more than 840 articles (book chapters, manuscripts and abstracts) on these subjects, and he is the editor of four textbooks on epilepsy. He has lectured widely throughout the world on topics related to pediatric epilepsy.

"Dr. Wheless is truly a gift to families and patients in our region and beyond. He is both one of the world's foremost experts in pediatric epilepsy treatment and research and does an amazing job of connecting with his patients and their families," said Interim President/CEO and Surgeon-in-Chief Trey Eubanks, MD. "We are so fortunate that the Horton and Wiener families are investing in our program and Le Bonheur. We depend on our generous community to help us build world-class programs like our Neuroscience Institute."

The investment from the Horton family and Ms. Wiener will be matched by Methodist Le Bonheur Healthcare to help ensure families can continue to rely on expert care at Le Bonheur Children's.

Le Bonheur's endowment is a permanent fund. Money earned from investment in the endowment is used to pay for programs, including Neuroscience, to help children and their families.

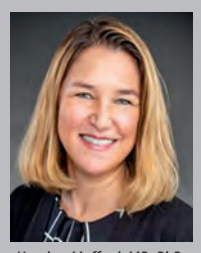
James Wheless, MD, Le Bonheur chief of Pediatric Neurology (third from right), is the first recipient of the Tom Horton and Donna Wiener Endowed Chair in Neuroscience. Wheless recently celebrated with the Horton and Wiener families. Pictured from left are Bowen Horton, Kylee Horton, Joy Wiener, Martha Horton, James Wheless, MD, Reagan Horton and Tommy Horton.

IN BRIEF

Le Bonheur's Comprehensive Epilepsy Program receives NAEC reaccreditation

The National Association of Epilepsy Centers (NAEC) recently reaccredited Le Bonheur's Comprehensive Epilepsy Program as a level 4 epilepsy center. This is the highest level that can be awarded to an epilepsy center and designates a center that provides more complex forms of intensive neurodiagnostic monitoring, as well as more extensive medical, neuropsychological and psychosocial treatment.

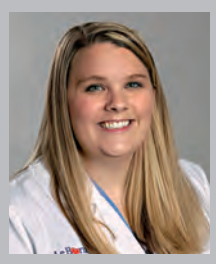
Mefford joins Le Bonheur's Neuroscience Institute



Heather Mefford, MD, PhD

Heather Mefford, MD, PhD, a physician scientist focused on genetics, epilepsy and neurodevelopmental disorders, recently joined Le Bonheur's Neuroscience Institute as a geneticist. She will be a part of the newly formed Epilepsy Genetics Clinic within the Neuroscience Institute. Mefford completed her residency in Pediatrics at Seattle Children's Hospital and a fellowship in Medical Genetics from the University of Washington.

Williams named a Tennessee Rising Star Nurse Leader



Brittany Williams, DNP, CPNP-PC, CNL

Le Bonheur Pediatric Neurology Nurse Practitioner Brittany Williams, DNP, CPNP-PC, CNL, was recently selected as a Tennessee Rising Star Nurse Leader by the Tennessee Nurses Association, Tennessee Hospital Association and Tennessee Action Coalition. Selection criteria for this recognition is based on leadership among peers, professional growth and development, contribution to building a culture of health in the community and commitment as a role model for health.

Castri joins Le Bonheur's Neuroscience Institute

Paola Castri, MD, PhD

Paola Castri, MD, PhD, Recently joined Le Bonheur's Neuroscience Institute as a pediatric neurologist. She completed her residency in Pediatric Neurology at the University of Tennessee Health Science Center and a Doctor of Philosophy in Clinical Neuroscience at University of Rome "La Sapienza." Castri is certified by the American Board of Psychiatry and Neurology and a member of the Child Neurology Society, American Academy of Neurology and the Newborn Brain Society.

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Brain Waves is a quarterly publication of the Neuroscience Institute at Le Bonheur Children's Hospital. The institute is a nationally recognized center for evaluation and treatment of nervous system disorders in children and adolescents, ranging from birth defects and learning and behavioral disorders to brain tumors, epilepsy and traumatic injuries.

Scan to learn more about our Neuroscience Institute.

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The "Best" Again!

U.S. News & World Report recently released its "Best Children's Hospitals" listings for 2023-24, naming Le Bonheur's Neuroscience Institute as a top Neurology & Neurosurgery program. This badge shows that Le Bonheur is the best place for kids, as we earned this recognition with strong outcomes and reputation. Le Bonheur's Neuroscience Institute believes children deserve the best Neurology and Neurosurgery care and have been able to sustain growth and continue to improve to be here for kids.

Le Bonheur hosts 16th Annual Pediatric Neurology Symposium

Thank you to all who attended the 16th Annual Pediatric Neurology Symposium! It was a weekend full of learning and discussion on the latest in pediatric neurology. This year, we presented the Kayden R. Vinson Distinguished Scholar and Lecture Award to Jay Salpekar, MD, FANPA, director of the Neuropsychiatry Center at the Kennedy Krieger Institute. This award, made in honor of epilepsy patient Kayden Vinson by her family, brings a leading scholar in pediatric epilepsy to the Mid-South to teach physicians.

Jay Salpekar, MD, FANPA, was the recipient of the 2023 Kayden R. Vinson Distinguished Scholar and Lecture Awards. Salpekar is director of the Neuropsychiatry Center at the Kennedy Krieger Institute.

SAVE THE DATE

17th Annual Pediatric Neurology Symposium

April 26-27, 2024

The Guesthouse at Graceland | Memphis, Tenn.

Registration will open early 2024.