Greenwood Genetic Center

Summer 2022

A Newsletter for the Friends of the Center

Race the Helix-Upstate

Families Supporting Families - p.4

Where

COMPASSION p.6

The genetic assistant, a new clinical professional, supports patient care

INSPIRES p.8

Research grant renewed to advance disease understanding and treatments

PROGRESS p.2

New diagnostic testing sequences whole genome to find answers

GGC Labs Getting More Answers Through Genome Sequencing

Genetic testing technologies are advancing at a breakneck pace. This is wonderful news for patients searching for a diagnosis. It offers the hope that a genetic change that wasn't detectable by prior testing methods, may now be identified. Many GGC patients are now finding answers though a new clinical test, Whole Exome Sequencing - XL (WES-XL).

GGC's Diagnostic Laboratories launched WES-XL for in-house patients in the fall of 2021. Until this time, the most advanced DNA sequencing test was whole exome sequencing (WES), which allowed for the interpretation of the coding regions of the 20,000 genes in the human genome.

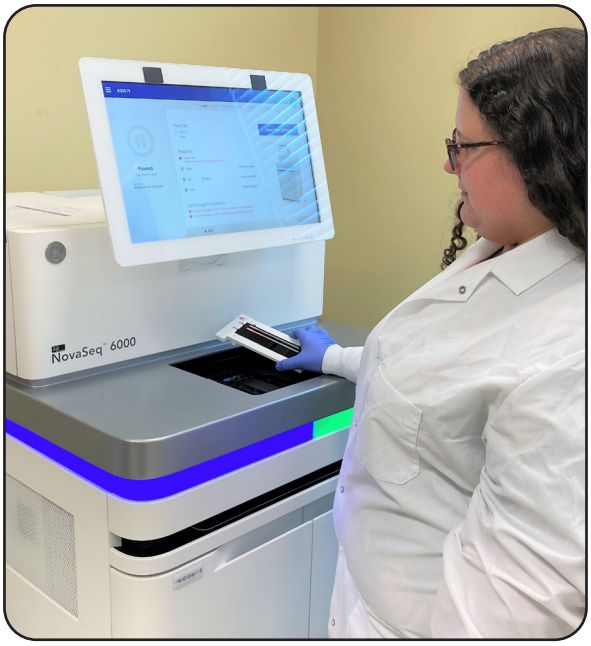
"WES testing provided answers for many patients, but there were still many left undiagnosed since WES data actually only comprises about 1-2% of the entire human genome," said Julie Jones, PhD, FACMG, Director of GGC's Clinical Genomic Sequencing Program. "By moving to WES-XL, we are actually sequencing the entire genome for each patient."

The new WES-XL clinical test generates each patient's entire three billion letter genomic sequence which includes:

- the coding regions of the approximately 20,000 individual genes that make proteins,
- all other noncoding and regulatory DNA segments that control the expression of these 20,000 genes, and
- copy number variants (CNVs) which are not errors in the DNA code itself, but are small sections of typical DNA that when present in too many or too few copies can cause clinical symptoms.

Once the actual DNA sequencing is complete, which takes about two days, GGC's bioinformatics team analyzes that data to identify any genetic variations and determine their significance. While the data generated does represent a true whole genome sequence, for this clinical test, the analysis is currently limited to looking at DNA sequences that are better understood.

"We all carry genetic variations, and the complicated part of this analysis is determining which of these DNA changes are simply benign human variation and which are actual mutations that cause disease," said Jones. "While we are currently only actively looking for DNA changes that are in areas of the genome that are more amenable to interpretation, we do have the patient's entire genome sequence that we can return to at a later date to reanalyze as our knowledge grows"



Jessica Cooley Coleman, PhD, lab manager in GGC's Molecular Diagnostic Laboratory, loads patient samples into the NovaSeq 6000 for sequencing.

According to GGC's Director of Diagnostic Development, Kellie Walden, MS, CGC, the average turnaround time for a result to be completed is approximately two months, though a few stat cases, where urgent treatment decisions are pending, have been completed in less than two weeks. "While the sequencing is completed relatively quickly using state-of-the-art technology, it takes significant time to process the large amounts of data and comb through all the variants to determine which of the changes, if any, are thought to cause the patient's condition," said Walden.

GGC's bioinformatics team uses complex algorithms to convert the sequence data from the NovaSeq to quality filtered files which are then uploaded to analysis software. This software uses artificial intelligence technology to identify gene changes and, by scanning the genomics literature and accounting for the patient's clinical symptoms, determine if any of those changes are significant.

To date, 289 WES-XL tests have been ordered with 199 completed. A genetic change has been identified in 60% of cases. Walden shared that many of these findings are classified as variants of uncertain significance, meaning that it is unclear whether the genetic change is causing the patient's symptoms. However, in 21% of patients, a pathogenic or likely pathogenic result was identified, meaning that the test did find a definitive or likely answer.

"We have also found diagnostic results in fifteen patients that would have most likely been missed by the prior whole exome sequencing technology," added Walden.

The WES-XL test is officially housed in the Molecular Laboratory at GGC; however, the interpretation involves teamwork across different GGC labs. While molecular lab directors are reviewing the DNA sequencing data looking for mutations, the cytogenetics lab directors are reviewing the CNV data to identify deletions or duplications.

"This is truly a team effort to provide such thorough results," said Jones. "From the accession team who processes the samples, the lab technologists who prepare and run the test, the bioinformaticists who manage the data, the molecular analysts, and lab directors who assess the significance of any changes and write reports, we all collaborate with the goal of getting an accurate and timely answer back to our families."

COOLEY COLEMAN EARNS PHD

Jessica Cooley Coleman, lab manager in GGC's Molecular Diagnostic Lab, earned a PhD in Healthcare Genetics and Genomics from Clemson University's School of Nursing this spring.

Dr. Cooley Coleman's dissertation research focused on better understanding and characterizing patients with mutations in the *MEF2C* gene which cause intellectual disability, absent speech, motor delays, autistic behaviors, and epilepsy. Patients with mutations in *MEF2C* have significant clinical overlap with features of other neurodevelopmental disorders, like Rett syndrome, with which GGC has extensive experience.

Dr. Cooley Coleman's project is the largest natural history study on *MEF2C*-related disorders to date and establishes a comprehensive review of developmental and clinical features for these disorders. Her data can help providers diagnose patients and form the basis for longitudinal or genotype–phenotype studies. Her paper was published in the journal *Molecular Genetics and Genomic Medicine* in April.

In July, Dr. Cooley Coleman will be promoted to staff scientist where she will assist with the implementation of innovation efforts for the diagnostic laboratories including the launch of novel testing platforms. She plans to begin GGC's Laboratory Genetics and Genomics Fellowship in the summer of 2023.

LAY RECEIVES PATTERSON BIOINFORMATICS AWARD

Drew Lay has been awarded the 2022 Susan R. Patterson Professional Development Award in Bioinformatics and Computational Genomics by the GGC Foundation.

The annual award recognizes the efforts of an individual at GGC whose primary professional role is to support and develop the bioinformatics and computational genomics work performed at the Center. The award will support Lay's continuing education and professional development in the field.

Lay joined GGC as a laboratory technologist in 2015. While continuing to work full time in the lab, he completed a Master of Science degree in Bioinformatics at Johns Hopkins University.

"Drew has played a significant role in GGC's collaboration with external organizations that provide artificial intelligence technology for genetic variant interpretation," said Mike Friez, PhD, Director of GGC's Diagnostic Laboratories,who nominated Lay for the award.

"As the data science and healthcare fields grow, bioinformatics is going to become even more important," said Lay. "It's a challenging, but fun discipline, particularly in the field of genetics, where the goal is often to help sift through large amounts of data in order to find the root cause of a patient's disorder."

FANG COMPLETES FELLOWSHIP

Xiaolan 'Alice' Fang, PhD has completed a three year fellowship in Laboratory Genetics and Genomics (LGG) through GGC's Medical Genetics Training Program.

Fang, a native of Hangzhou, China, completed her undergraduate studies at Shanghai JiaoTong University in Shanghai, China. She earned a Ph.D. in Biology from the University of Virginia and continued her work in cancer genetics and molecular biology as a research fellow at Wake Forest School of Medicine, where she evaluated biomarkers and molecular mechanisms in prostate cancer.

Fang joined GGC as an LGG fellow in the summer of 2019 where she trained in the implementation and interpretation of both molecular and cytogenetic diagnostic tests, as well as the development and validation of novel assays for use in clinical settings.

Fang has accepted a position in the Department of Pathology at Henry Ford Hospital in Detroit, MI where she will interpret cytogenetic and molecular genetic testing for their oncology service.

"I am grateful to my colleagues and mentors at GGC, and have benefitted a lot from GGC's great reputation in the field," said Fang.

Levi Puskas leaps across the finish line at Race the Helix-Upstate.
Cover:The Puskas family at Race the Helix-Upstate

A FAMILY AFFAIR

GGC families play important role in Race the Helix

It was December 3, Phenylketonuria (PKU) Awareness Day, in 2018 when Jeremy and Dianna Puskas of Greenville, SC got the call that would change their lives forever - their adoption agency had a match! A two-year-old boy in China was in need of a home, but he had been diagnosed with PKU, a metabolic disorder, and the agency suggested that they consult with a specialist before moving forward with the adoption.

The Puskases were referred to GGC's metabolic clinic where children and adults with PKU are treated and followed by a team of experts in metabolic disorders. Dr. Neena Champaigne met with the prospective parents. "She was so good at answering our many questions and helping us feel like we could manage his needs," recalls Jeremy.

Individuals with PKU are unable to make an enzyme called phenylalanine hydroxylase (PAH) which metabolizes proteins from the diet, specifically the amino acid phenylalanine (phe). The treatment for PKU, which is generally identified through newborn screening, includes a restricted diet that is low in protein, especially phe.

"Elevated phe levels can be very detrimental, especially for young children," said Meaghan Bade, RN, a nurse in GGC's metabolic clinic. "If left undiagnosed or untreated, high phe levels can cause growth issues, seizures, and significant developmental and intellectual disabilities."

"All we knew when we brought Levi home was what he had been eating, which was not standard fare for PKU, and his recent phe levels," added Jeremy. "We knew nothing else about his medical history."

"Any time we have an issue, all I have to do is tell GGC, and they take care of it. It's like magic! Levi would not be where he is today, either with his health intact or even as a part of our family, without GGC."

-Dianna Puskas, mom of Levi

Once Levi joined his new family and was under the care of GGC's metabolic team, they noticed that his blood work didn't fit with the typical PKU patient. Additional testing revealed that Levi didn't actually have PKU, but a similar disorder called 6-PTPS deficiency. By getting to the correct diagnosis, Levi's treatment changed allowing him to consume a normal diet and manage his disorder through medication alone.

"Once we had the right diagnosis and were able to start a more normal diet, there was a huge improvement in Levi's mood," said Dianna. "It's amazing how much happier two-year olds are when they aren't hungry!"

Levi was also experiencing mild developmental issues when he first came to GGC, but through careful monitoring and his medical management, he is thriving. "It was like parts of his brain turned on for the very first time," added Dianna.

In the early days of the pandemic, when employees were feeling disconnected, Dianna's colleagues at Edward Jones in Greenville decided to come together for a service project which has evolved into a regular quarterly event. Dianna started a fundraiser for the group with all proceeds benefitting Race the Helix-Upstate.

"I'm so grateful for the support we have received from GGC. Even before we were technically 'patients,' they gave us the confidence and knowledge to adopt this extra-special boy," said Dianna. "They didn't take his diagnosis at face value, and instead went the extra mile to find his correct diagnosis which is the only reason his brain now works the way it should."

"Levi is funny, kind, and adventurous," added Dianna. "He wants to be a 'fireman who rides a motorcycle into space' when he grows up, and he loves running, like his dad. And as much as he likes to win, he also likes to celebrate who 'won next.' He was right at home at Race the Helix!"

The funds raised by Dianna and her colleagues for Race the Helix-Upstate support the GGC Cares Fund providing coverage for vital genetic testing for patients who are uninsured or underinsured.

After cancelling the 2020 race and holding the 2021 event virtually, the GGC team was excited to be back in person for Race the Helix-Upstate this year. The 8th annual event was held on April 30 at Conestee Nature Park in Greenville, SC.

"Our wonderful team of volunteers, generous sponsors, and enthusiastic participants made my first Race the Helix such an amazing experience," said Cady Nell Keener, Executive Director of the GGC Foundation. "It was a thrill to meet several GGC families, like Levi's, who shared such wonderful stories about the care they receive at the Center."

The Connor family (L-R) Charlie, Brooks, and Wes, share their journey each year as the host family for Race the Helix-Upstate.

Brooks Connor, mom to Charlie, 13, who has been followed by GGC since he was a newborn, agreed. "When Charlie was diagnosed with isovaleric acidemia at five days old, he was the only child in South Carolina with that diagnosis. We felt so alone. But once we connected with GGC, we knew we were not alone. They have been there every step of the way to support not only Charlie, but our whole family."

The Connors have been the host family for Race the Helix-Upstate since its inception - sharing their GGC story and participating in planning the event. "We love being part of Race the Helix to help support the work of this amazing place. We call our GGC team 'Charlie's Angels' because that's what they have been to our family," added Brooks.

Race the Helix started as the idea of another family who wanted to do something to give back to GGC after their daughter's diagnosis.

Ryleigh Shenal, 11, was diagnosed at GGC shortly after birth with a rare deletion of part of chromosome 1.

Ryleigh's mom, Jodi recalls, "I'll never forget the feeling when Dr. Skinner called to tell us the results of the genetic testing. We were frightened, worried, and had no idea where to turn next. Then he said 'Remember. Ryleigh is the same beautiful baby she was before this call.' Those words have stayed with me through all of these years, and we are eternally grateful for all that GGC has done for our family."

Out of that appreciation, Race the Helix was born. The Shenal family planned the first event in Greenwood in 2011 with the hope of raising awareness of genetic disorders and funds to support GGC's work.

"Now, 12 years, 21 races, and hundreds of thousands of dollars later, Race the Helix is still having a tremendous impact on GGC and the patients and families we serve every day," added Keener.

GGC Cares Fund Update

Relieving financial burdens for GGC families

The GGC Foundation launched the GGC Cares Fund in 2020 to provide direct assistance to uninsured or underinsured families who are in need of genetic testing.

"GGC has always been committed to providing medically necessary genetic testing to patients, even when the family is unable to pay," shared GGC Director, Steve Skinner, MD. "The GGC Cares Fund allows us to cover the cost of this testing and provides a way for our donors to make a direct impact on the families we serve."

Over $24,000 in proceeds from Race the Helix-Upstate this spring also supported this worthwhile endeavor. Eligible patients may be nominated by their GGC provider or identified through the Center's business office. To date, 27 patients have been nominated for financial support through the GGC Cares Fund.

"By supporting the GGC Cares Fund, donors can have an immediate and direct impact on families to help defray the cost of genetic testing," said Cady Nell Keener, Executive Director of the GGC Foundation. "If we can alleviate worries over how to pay for genetic testing, that's another way that GGC can compassionately support our families in the midst of challenging circumstances."

To support to the GGC Cares Fund, visit www.ggc.org/foundation/donate.

Save the Date!

October 8, 2022

RACE THE HELIX Greenwood

Register at runsignup.com

A New Clinical Role: Genetic Assistants

With a nationwide shortage of clinical geneticists and genetic counselors, clinics must get creative to manage the demand for genetic services and avoid long wait times for appointments. One way that GGC and other genetics organizations are addressing this workforce shortage is through the addition of a new professional - the genetic assistant.

Genetic assistants (GAs) typically have a bachelor's degree in a health-related or scientific field and support geneticists and genetic counselors by managing administrative tasks in the clinic setting. They assist with referrals, scheduling, sample coordination, and billing activities associated with patient visits. GGC currently employs four genetic assistants, one each in the Center's Greenwood and Greenville locations and two in the Charleston office.

Alli Davis joined GGC's Charleston office in 2021 as a genetic assistant in the metabolic clinic where she assists with tasks such as scheduling, coordinating testing, requesting insurance authorizations, and creating genetic lectures.

"One of the things I love most about being a GA is having the opportunity to directly impact a patient and their family's experience with GGC," shared Davis. "I have had the pleasure of meeting many unique and wonderful patients and families during my time at GGC!"

In metabolic clinics, many of the patients are followed and treated long term, which is something Davis enjoys about her role. "It is wonderful to watch the patients grow and thrive throughout the years we see them."

GAs at GGC have also become involved in implementing workflows for eConsults and eVisits.

"GGC was awarded a grant from The Duke Endowment to develop a program to improve access to genetic services by having GGC providers communicate asynchronously with non-genetics providers (eConsults) and with our patients (eVisits)," said Mike Lyons, GGC's Director of Clinical Services. "Part of that grant specifically covered the addition of genetic assistants. Our GA in Greenwood, Mattie Piotrowski, has been a critical part of the development of this innovative approach to genetics care."

Piotrowski has helped to create the workflows for eVisits, which are offered to patients who are due for a follow-up appointment.

"eVisits allow the patient to connect with their provider through a secure online platform at their convenience," said Piotrowski "They can check in, get their questions answered, and if recommended, we can even coordinate additional genetic testing through this platform."

One of Piotrowski's main roles has been to educate patients on the availability and benefits of eVisits.

Alli Davis (right), a genetic assistant in GGC's Charleston office, works with genetic counselor, Aubrey Rose, MS, CGC, to prepare for an upcoming patient visit.

"Once I explain how eVisits work and the convenience of not having to travel or wait for an appointment, we have had many follow-up patients complete eVisits with great success," Piotrowski explained. "This also opens up appointments for new patients or those who prefer or need in-person care, reducing their wait times."

With the growing impact of GAs on GGC's patient care, GGC's Division of Education has partnered with Lander University's School of Nursing to develop a Genetic Health Studies certificate program to prepare students to work as a GA in a genetics clinic.

Holisa Wharton, PhD, Dean of the William Preston Turner School of Nursing at Lander and a member of GGC's Board of Directors, worked closely with Leta Tribble, PhD, GGC's Director of Education to develop the curriculum.

"The certificate program at Lander is co-taught by Lander nursing faculty and GGC faculty. The five course sequence covers topics such as pedigree construction and analysis, laboratory testing, and genetic treatments," said Tribble. "Students also have the opportunity to complete a rotation at GGC to observe in clinics and practice skills to assist with patient care."

"The skills and experience that GAs acquire in patient care settings also makes them well suited to advance their education in genetic medicine," added Tribble. "Several previous GAs at GGC have moved on to graduate programs in genetics or genetic counseling."

Davis and Piotrowski both became genetic assistants to gain exposure to clinical genetics with plans to pursue careers as genetic counselors.

"One of the biggest reasons why I chose to become a part of the GGC family was their commitment to promote compassion and care for patients and their families," added Davis.

GGC & Clemson CHG Collaborate on Grant

Cure Sanfilippo Foundation has awarded funding to Trudy Mackay, PhD, of Clemson University's Center for Human Genetics (CHG) to better understand this rare disorder and identify potential treatment targets. GGC's Rich Steet, PhD, Director of Research, and Heather Flanagan-Steet, PhD, Director of Functional Studies, are collaborators on the project.

Sanfilippo syndrome is a rare neuro-degenerative disease that causes developmental regression, seizures, and movement disorders. It has been likened to a childhood version of Alzheimer's disease with death often by the second decade of life.

Cure Sanfilippo Foundation was started by Glenn and Dr. Cara O'Neill of Columbia, SC after their daughter, Eliza, was diagnosed by GGC. Their family-led foundation has raised millions of dollars since her diagnosis to fund research and clinical trials.

Through the current grant, Mackay and her team will work with drosophila, (fruit fly) models of Sanfilippo syndrome to characterize specific patient mutations and to test for gene modifications that alter the severity of the disease.

Drosophila are an excellent genetic model system since they mimic 75% of the human genome, are cost efficient to grow and maintain, and due to a naturally-short lifespan are able to provide more rapid results.

There is an incomplete understanding of how the Sanfilippo disease process impacts patients' neurological function. This incomplete knowledge creates a barrier for identifying new therapeutic strategies. To address this barrier, Mackay will cross flies with Sanfilippo mutations with her reference fly lines to identify which 'non-Sanfilippo' genes most significantly affect disease severity.

GGC's Steet and Flanagan-Steet, who have expertise in lysosomal storage disorders like Sanfilippo syndrome, will examine the biochemical, pathological, and behavioral impacts of these genetic alterations, also called genetic modifiers. They will also test the impact of the modifiers found in the flies in their zebrafish models - extending the studies into a second model system.

Identifying other genes that modify the severity of symptoms or the lifespan of individuals with Sanfilippo syndrome may reveal new understanding of the disease mechanism and new therapeutic targets or biomarkers. If the genes identified are able to be targeted by FDA-approved drugs, an expedited pathway toward human clinical trials may be possible.

"We are excited to partner with Dr. Mackay's team at Clemson and Cure Sanfilippo Foundation on this project," said Flanagan-Steet. "The collaboration between scientists and family organizations is vital for the advancement of our understanding and ultimately the development of life-changing and life-saving treatments for rare diseases like Sanfilippo syndrome."

Photo: Clemson and GGC collaborators (L-R), Robert Anholt, PhD, Trudy Mackay. PhD, Heather Flanagan-Steet, PhD, and Rich Steet, PhD

INCOMING GGC FELLOW EARNS ACMG AWARD

Nikhil Sahajpal, PhD, who will be starting his Laboratory Genetics and Genomics (LGG) Fellowship at GGC in July, was presented with the LGG Next Generation Fellowship Award by the American College of Medical Genetics and Genomics Foundation. The award, which will help fund Sahajpal's GGC fellowship, was presented at the college's annual meeting in Nashville in March.

Sahajpal joins GGC from a post-doctoral fellowship at Augusta University, GA. He completed his PhD at Guru Nanak Dev University, Amritsar, India in 2020 where he studied the pathophysiology of diabetic retinopathy. Dr. Sahajpal has been the recipient of several international awards and has published 35 manuscripts in peer-reviewed journals utilizing various molecular and cytogenetic methodologies. At Augusta University, he played a key role in establishing their COVID 19 FDA-EUA approved diagnostic testing.

"I feel delighted and honored to receive this prestigious award from the ACMG Foundation," said Sahajpal. "I am humbled by this amazing opportunity given to me by the selection committee of the ACMG Foundation to further my career development in the field of laboratory genetics and genomics at the GGC."

L-R: Alka Chaubey, PhD, Chief Medical Officer at Bionano, one of the award's sponsors; Sahajpal; and Mike Friez, PhD, Director of GGC's Diagnostic Laboratories, at the ACMG award ceremony.

GGC's Director of Research, Rich Steet, PhD, outside the JC Self Research Institute

RENEWED PURPOSE

Steet's Grant Renewal Extends LSD Work Through 2026

Lysosomes are often described as the recycling centers of the cell. They are membrane bound structures within each cell containing digestive enzymes that, among other functions, break down waste products. When those enzymes are not produced due to a genetic mutation, or when the broken down molecules can't get out of the lysosome, this leads to storage of harmful substances inside the lysosome leading to the aptly named, lysosomal storage disorders.

There are numerous types of lysosomal storage disorders (LSDs), each characterized by the type of lysosomal enzyme that is deficient, and they are of great interest to GGC researchers.

Rich Steet, PhD, GGC's Director of Research, has spent years studying the function of lysosomes and how their abnormal function results in the clinical features associated with LSDs. While the clinical features vary between different types of LSDs, common findings include coarse facial features, cardiac and skeletal anomalies, learning difficulties, and a shortened life span.

"We are excited by the potential to further unravel the mysteries of lysosomal storage disorders and... that it allows us to expand our work into patient-specific projects here at GGC."

-Rich Steet, PhD

To continue this groundbreaking work, Steet and co-principal investigator and GGC's Director of Functional Studies, Heather Flanagan-Steet, PhD, have recently secured a four-year renewal of their long-standing grant titled 'Pathogenic Mechanisms of Lysosomal Disease.'

The grant, which is administered by the National Institute of Neurological Disorders and Stroke (NINDS), a division of the National Institutes of Health (NIH), provides $1.2 million over four years to continue the team's ongoing work to better understand the mechanisms behind LSDs. The funding, which is classified as an R01 grant through the NIH, is the original and historically oldest grant mechanism used by NIH. The R01 provides support for health-related research and development that is consistent with the mission of the NIH. An R01 is for mature research projects that are hypothesis-driven with strong preliminary data and are the most competitive of NIH funding sources.

Prior research under this grant focused on a single disorder, mucolipidosis, type II (MLII). The research team has made significant progress in understanding how MLII symptoms develop and they have been able to successfully treat cardiac and skeletal disease manifestations in their zebrafish models. This breakthrough has fostered collaborations to advance treatment studies into a mammalian model with the ultimate goal of developing an effective therapy for patients with this rare disease.

Heather Flanagan-Steet, PhD, co-principal investigator on the grant, works with zebrafish embryos.

"We are pleased that our prior work on LSDs has been so fruitful and that we are able to continue to move toward better understanding and novel treatment options for families impacted by LSDs," said Steet.

The primary hypothesis for this new round of funding is that the mechanisms identified in MLII disease are similar across other LSDs, which could lead to novel therapies for several disorders.

The grant renewal will also allow the research team to expand their work on the NUS1 gene which came to the team's attention through a GGC patient, Chloe. Chloe was referred to GGC at age 12 to investigate a movement disorder that was causing tremors, seizures, and learning difficulties. Whole exome sequencing was completed, and a variant was identified in the NUS1 gene.

"Chloe's variant had never been reported before, so we were unsure of its significance," shared Mike Lyons, MD, GGC's Director of Clinical Services and Chloe's clinical geneticist. "We reached out to Dr. Steet's lab to get their help in understanding if the variant was the cause of her symptoms."

Through both cellular and zebrafish experiments, researchers were able to confirm that Chloe's variant was causing her movement issues. They were also able to identify the likely mechanism and a possible therapy.

The grant also supports the work of Steet's research team which incudes post doctoral associates, Jen-Jie Lee, PhD (left) and Po-Nien Lu, PhD, (right) seen here preparing to collect zebrafish embryos for study.

"Zebrafish that mimic Chloe's NUS1 variant not only exhibited a movement disorder as seen through abnormal swimming patterns, but they also displayed significant accumulation of cholesterol in their lysosomes," said Flanagan-Steet. "By using an FDA-approved small molecule, we were able to reduce cholesterol storage in the zebrafish and restore normal swimming behaviors."

The additional funding through the grant renewal will also help the research team to refine how the storage of cholesterol in the lysosomes occurs in patients with NUS1 mutations and why it leads to the neurological symptoms and movement disorders.

"After completing 13 years of research through this grant funding, we are excited by the potential to further unravel the mysteries of lysosomal storage disorders and identify novel treatments that can help patients like Chloe and the thousands of others who are impacted by LSDs," said Steet. "While this renewal continues to support our ongoing basic research, we're thrilled that it also allows us to expand our work into patient-specific projects here at GGC."

An Eye on Testing and Treament

GGC teams up with MUSC to assess inherited retinal disorders

Clinicians from GGC's Charleston office have teamed up with MUSC on a project to evaluate the rates and genetic etiologies of inherited retinal disorders, specifically in South Carolina.

"With the availability of new genetic testing methodologies like whole exome and whole genome sequencing, we are now able to identify new genetic variants that cause a variety of conditions, including retinal disorders," said Meg Wilkes, MS, CGC, a genetic counselor in GGC's Charleston office *(pictured right)*.

For the project, Wilkes reviewed records on patients with an inherited retinal disease who have been seen at GGC over the past few years to determine the use and utility of genetic testing for these disorders. The team was able to estimate the prevalence of various inherited retinal disorders in SC and compare that to national statistics.

A manuscript entitled "Inherited Retinal Dystrophy in South Carolina: Characterization and Literature Review," has been submitted for publication by the collaborators led by MUSC medical student, Joseph Griffith.

"Our project highlights the importance of genetic testing for retinal disorders, especially now that a quick and accurate diagnosis may lead to an improvement in therapeutic interventions that could prevent or ameliorate symptoms of these rare disorders, preserving a patient's eyesight," added Wilkes.

NEW GGC FOUNDATION TRUSTEES

The Greenwood Genetic Center (GGC) Foundation has appointed five new members to its Board of Trustees. GGC Foundation trustees serve as mission ambassadors by cultivating, securing, and stewarding philanthropic funds that advance the Center's mission for the benefit of the patients and families served by GGC. They also manage all fiduciary responsibilities and activities of the Foundation.

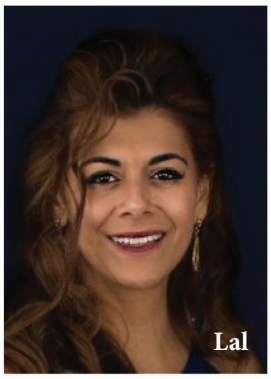
The new members are:

- **Mark Askew** of Greenwood, Board Chair for Palmetto Surety Corporation and United Holding Group. He serves on the boards of the Self Regional Healthcare Foundation and Greater Greenwood Habitat for Humanity.
- **Wells Dunlap** of Greenwood, a Vice President and Commercial Relationship Manager at the Countybank. He is a graduate of Leadership Greenwood and South Carolina Banking School.
- **Megha Lal** of Greenwood, a member of the Countybank Board of Directors. She is also involved in numerous Greenwood community organizations including the Self Regional Healthcare Foundation, Greenwood Promise, Arts Council, and Greenwood County Community Foundation.
- **Chris Singleton** of North Charleston, a former minor league baseball player and nationally-renowned speaker with a message of resilience, forgiveness, and unity following the loss of his mother, Sharonda Coleman Singleton, in the 2015 Mother Emanuel Church tragedy in Charleston, SC.
- **Tara Smith** of Greenwood, Office Manager for the Law Offices of Brandon A. Smith and wife of the current Mayor of the City of Greenwood. She is a member of the Rotary Club of Greenwood and is a board member for Keep Greenwood County Beautiful.

"We are pleased to welcome each of these new members to the Board," said GGC Foundation Board Chair, Bill Stevens. "Each brings unique expertise and a passion to advance our mission to support the amazing work being done at the Greenwood Genetic Center each day for patients and families across South Carolina and around the world."


Askew


Dunlap


Lal


Singleton


Smith

GGC Foundation Funds Lab Modernization


Julie Rodgers of GGC's Diagnostic Labs prepares a sample for genetic testing.

Gifts to the GGC Foundation totaling $750,000 have resulted in the acquisition of a new Laboratory Information Management System (LIMS) to support the Center's modernization efforts.

"LIMS is a powerful new software technology used to manage diagnostic workflow from the time a test is ordered until a final clinical report is delivered," said Mike Friez, PhD, Director of GGC's Diagnostic Laboratories. "Updating GGC's LIMS will add precision, speed, capacity, and efficiencies to both our diagnostic and research programs."

The new system is being customized and configured across the Center's laboratories in several phases, with full implementation expected later this year.

"We are thrilled to be able to support this vital technology that will allow GGC to continue to be a leader in the provision of high-quality, state-of-the-art genetic testing," said Cady Nell Keener, Executive Director of the GGC Foundation. "This project would not be possible without the generosity and vision of organizations such as the Self Family Foundation, Mutual of America Financial Group, and the numerous private donors who supported these efforts."

GGC and MUSC Join Forces to Improve Genetic Services in SC

GGC and the Medical University of South Carolina (MUSC) have finalized a membership agreement designed to improve genetic services for patients across South Carolina and beyond.

"GGC and MUSC have a common mission to improve the lives of patients across South Carolina," said GGC Director, Steve Skinner, MD. "We share a vision of the role of genetics in medicine that neither of us can accomplish on our own. MUSC recognizes the importance of genetics and genomics to the future of healthcare, and that's an area where GGC already excels as a leader. We both have a common goal to make state-of-the-art genetic services available and accessible to all to improve the health and lives of our patients and of our state. It's a natural fit."

The agreement has restructured GGC into a nonprofit with members. A new 12-member board of directors has been appointed, six by GGC and six by MUSC. The new board will oversee GGC's annual budget, review strategic directions for GGC, maintain responsibility for compliance and proper business practices, and maintain fiduciary oversight of the Center. The new board will have their first meeting in late June.

The previous GGC Board of Directors remain in place as the GGC Holdings Board and, along with the Mainsail Board of Directors (a subsidiary of MUSC), serve as the two members of the restructured GGC. Both members have certain oversight responsibilities regarding regulatory and financial issues under the Membership Agreement. The GGC Foundation will continue to support the mission of GGC.

"We are excited about the opportunity to expand our services through MUSC's expansive networks and expertise in healthcare," added Skinner. "MUSC will enhance our operations from healthcare administration and business expertise to cutting edge treatments and clinical trial development for our patients."

"GGC and MUSC are like-minded organizations with a common vision of providing quality, state-of-the-art healthcare," said Dell Baker, chair of the GGC Board of Directors who voted to approve the agreement in March. "Combining our strengths and resources is a win-win-win. It's good for GGC. It's good for MUSC. And, most importantly, it is good for the patients of GGC and the families of South Carolina."

Strategic initiatives between the two organizations will be led by several working groups that will plan and implement activities such as improving access to clinical care, advancing technology for diagnostic testing and research, optimizing billing and reporting capabilities, and expanding educational outreach.

The collaboration will also involve a joint operating committee comprised of administrative leaders of GGC and MUSC. This committee will serve in an advisory role to facilitate operations between the two organizations and mobilize resources for the activities of the working groups.

"We are excited to begin our work together," said Skinner. "With the genetics expertise of GGC and the resources and influence of MUSC, we anticipate growth in both organizations and advancements and improvements in genetic health for all South Carolinians."

To learn more about the agreement and find answers to frequently asked questions, visit

www.ggc.org/ggc_musc_affiliation

Greenwood Genetic Center

Where Compassion Inspires Progress

MUSC Health

Medical University of South Carolina

Meet the NEW BOARD OF DIRECTORS

GGC Appointees

Dell Baker - Greenville, SC

Howell Clyborne - Campobello, SC

John Miller - Anderson, SC

Jay Nexsen - Greenwood, SC

Chris Przirembel, PhD - Greenville SC

Holisa Wharton, PhD - Greenwood, SC

MUSC Appointees

Terri Barnes - Rock Hill, SC

Henry 'Fritz' Butehorn, MD - Greer, SC

Richard Christian, MD - Greenwood, SC

Reid Conrad- Ninety Six, SC

Charles Schulze- Greenwood, SC

William 'Bill' Stevens - Greenwood, SC

The Greenwood Genetic Center is a nonprofit institute organized to provide clinical genetic services, diagnostic laboratory testing, educational programs and materials, and research in the field of medical genetics.

Greenwood Genetic Center
106 Gregor Mendel Circle
Greenwood, SC 29646

106 Gregor Mendel Circle
Greenwood, SC 29646

Tel: 864-941-8100
Toll Free: 888-442-4363

www.GGC.org