

Harvey and Marcia Schiller Surgical Innovation Center

Progress Report 2023

Message from the Director

The Harvey and Marcia Schiller Surgical Innovation Center at the Medical University of South Carolina is a dedicated center for surgical innovation that aims to improve patient outcomes and healthcare efficiencies. The Center includes three pillars: surgical artificial intelligence, investigator-initiated clinical trials, and human-centered design.

The Schiller Surgical Innovation Center is a think tank, an incubator of ideas, a healthcare AI / ML accelerator, and a dedicated engine of healthcare innovation, fueling the surgical innovation space with new ideas and new products to solve some of the most challenging problems in patient care.

A major focus of the Center is in harnessing the massive quantities of healthcare data to develop predictive models that can be used for individualized patient care and for supporting clinical decision-making. We also focus on developing algorithms that can accurately and in an automated fashion interpret imaging studies, and use AI/ML and natural language processing to accurately and rapidly extract data from the electronic health records.

We are fortunate at MUSC to have a very fertile environment for innovation. Our Center is filled with energy and momentum from a diverse group of people who understand AI/ML and how it can be incorporated into healthcare. Thanks to the generous gift from the Schillers, we were able to rapidly develop AI/ML teams, build the needed data infrastructure, and begin partnering with MUSC Health clinicians and researchers interested in using AI/ML for surgical innovation. We now have more than thirty ongoing projects with the foundation and partnerships in place to expand our reach. With this growth in mind, the Center is in the process of establishing a physical location on campus with offices and meeting space to foster and enhance more collaborations.

Our Human-Centered Design and Clinical Trials sections of the Schiller Surgical Innovation Center have also been exceptionally productive. The HCD program has created more than ten student-led startups, some with significant funding, and the department has seen a steady increase in clinical trials over the past several years, with significant growth in industry-sponsored research and investigator-initiated clinical trials.

These strategic initiatives and many more that you will read about in this progress report illustrate how we are poised to shape the future of surgical innovation. If you have a project you are interested in exploring, I encourage you to meet with one of our scientists.

Arman Kilic, M.D.

*John M. Kratz, M.D. Endowed Chair in Cardiac Surgery and Research
Director of the Harvey and Marcia Schiller Surgical Innovation Center*



*Arman Kilic, M.D.
Director*

Meet the Team

AI, MACHINE LEARNING & NATURAL LANGUAGE PROCESSING SURGEON-SCIENTISTS AND RESEARCHERS



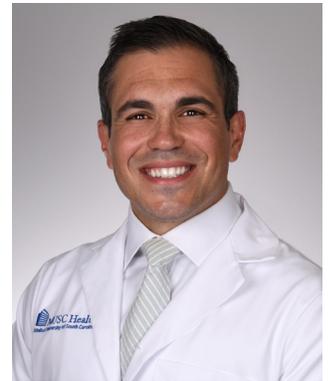
Arman Kilic, M.D.
Cardiothoracic Surgeon



Ian Bostock, M.D., MS
Thoracic Surgeon



Thomas Brothers, M.D.
Vascular Surgeon



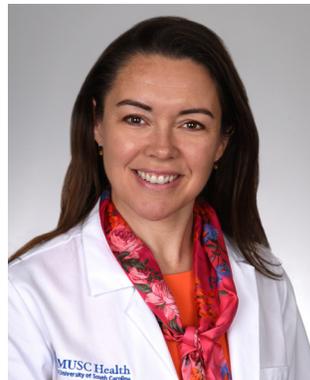
Thomas Curran, M.D., MPH
Colorectal Surgeon



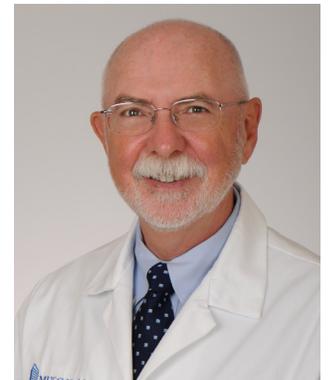
Evert Eriksson, M.D.
Acute Care Surgeon



Kate Engelhardt, M.D., MS
Thoracic Surgeon



Heather Evans, M.D., MS
Acute Care Surgeon



Kevin Hughes, M.D.
Surgical Oncologist



Rupak Mukherjee, Ph.D.
*Cardiothoracic Surgery
Researcher*



Deepak Ozthathil, M.D.
Burn Surgeon



Ravi Veeraswamy, M.D.
Vascular Surgeon

Data and AI Scientists

John Del Gaizo, Ph.D., Lead AI Researcher, leads a team of AI researchers that aims to facilitate AI research in the Harvey and Marcia Schiller Surgical Innovation Center. The team offers AI consultation and prototyping, and access to advanced computational hardware for MUSC Department of Surgery researchers and external collaborators.



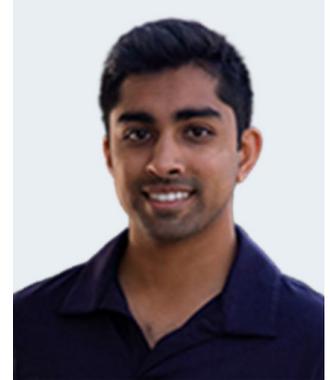
Brett Welch, MBA, MHA
Program Manager



Khaled Shorbaji, M.D., MPH
Surgical Outcomes
Research Manager



Ahmed Alameldin
AI Researcher



Roshan Mathi, MS
AI Researcher

Who Do We Serve?

Our AI scientists help with teams that lead collaborative grants, we engage with department surgeons to understand gaps in clinical knowledge and practice, and we support device innovation and translation of AI and non-AI prose into clinical trials. We utilize the MUSC data infrastructure to extend and build our infrastructure in the surgical innovation center for clinical operations, digital transformation, and quality improvement.

What is Our Innovation Pipeline?

Our pipeline is intended to impact the tripartite mission for the Department of Surgery:

- Clinical Care
- Research
- Education



Clinicians and researchers who have a clinical idea or have identified a clinical gap can submit their idea to the Surgical Innovation Center for inclusion in the portfolio. The Center then helps develop the plan for data acquisition, data analysis, and dissemination. Our AI scientists can also help identify potential partner sites.



A Sampling of Our Current Innovation Portfolio

With more than thirty AI /ML/NLP ongoing trials, listed below is a sampling of the breadth of our portfolio.

Ian Bostock, M.D., MS <i>Thoracic Surgeon</i>	<ul style="list-style-type: none">Utilizing machine learning algorithms to analyze preoperative PET-CT scans to determine the likelihood of complete pathologic response after neoadjuvant chemoradiation in patients with esophageal cancer remission.
Thomas Brothers, M.D. <i>Vascular Surgeon</i>	<ul style="list-style-type: none">Developing risk models and providing clinical decision support in peripheral vascular disease.
Thomas Curran, M.D., MPH <i>Colorectal Surgeon</i>	<ul style="list-style-type: none">Utilizing machine learning for personalized venous thromboembolism (VTE) risk prediction and management recommendations for VTE prophylaxis.
Evert Eriksson, M.D. <i>Acute Care Surgeon</i>	<ul style="list-style-type: none">Applying artificial intelligence to chest wall injury for chest wall reconstruction surgery.Utilizing artificial intelligence to determine factors associated with unstable chest wall injuries.Utilizing machine learning to analyze radiology reports to identify patients with non-healing rib fractures that would benefit from rib fixation treatment.
Kate Engelhardt, M.D., MS <i>Thoracic Surgeon</i>	<ul style="list-style-type: none">Using AI to predict visceral pleural invasion in non-small cell lung cancer.
Heather Evans, M.D., MS <i>Acute Care Surgeon</i>	<ul style="list-style-type: none">Developing infrastructure for participation in an established federated learning consortium with the University of Minnesota.
Kevin Hughes, M.D. <i>Surgical Oncologist</i> <i>Director, Cancer Genetics</i>	<ul style="list-style-type: none">Using AI/NLP to help organize a Cancer Genetics Knowledge Base and build clinical decision support tools.Using graph database technology for Cancer Susceptibility Gene Visualization to enhance education and understanding of cancer genetics.Organizing and mapping disparate data sources to a Central Breast Cancer Database that is used for machine learning, clinical care and research.
Arman Kilic, M.D. <i>Director</i> <i>Cardiothoracic Surgeon</i>	<ul style="list-style-type: none">Applying artificial intelligence to heart transplant allocation in the United States.Utilizing AI and machine learning for clinical decision support, matching recipients and donors for heart transplants in the U.S.Developing dynamic machine learning models to predict mortality in the cardiovascular ICU.
Rupak Mukherjee, Ph.D. <i>Professor, Cardiothoracic Surgery</i>	<ul style="list-style-type: none">Utilizing natural language processing to evaluate applications for surgical residency programs.
Deepak Ozhathil, M.D. <i>Burn Surgery</i>	<ul style="list-style-type: none">Utilizing next generation sequencing (NGS) technology to collect data about the microbiome and metagenomics of the burn wound and establish a data and bio-repository.
Ravi Veeraswamy, M.D. <i>Chief, Vascular Surgery</i>	<ul style="list-style-type: none">Applying artificial intelligence for better stroke risk prediction using carotid imaging data.

Our Data Infrastructure

Our team utilized the MUSC current data infrastructure of SPARC and Epic, and we are helping to build a more expansive data infrastructure for clinical operations, digital transformation, and quality improvement. Our goal is to have each physician-scientist and quantitative collaborator have at least one A100 GPU processor, designed to accelerate deep learning and AI.

DEEP LEARNING IS ITERATIVE



We have powerful Analysis AI Servers:

- Dell Precision 7920 (40 GB; dual CPU; AI mid-range server)
- Dell PowerEdge R750XA (80GB; A100 GPU & SXM4 inter-GPU connections, AI high-range server)

Our agile approach compares the Azure cloud computing versus on-premise project implementation to provide the most efficient, cost-effective and seamless data analysis depending on the project's needs.

To accelerate our process of combining data from multiple sources into a large, centralized depository, commonly referred to as ETL (extract, transform and load) we are engaging with the MUSC Biomedical Informatics Center (BIMC) to invest in data engineers that are supported and fully committed to the Harvey and Marcia Schiller Surgical Innovation Center.

The goal is for the BMIC engineers to create a meta-layer of analysis-ready data for our projects.

Our Services

We provide high throughput and high fidelity models to bring your innovative idea to fruition.

Please contact Arman Kilic, M.D. at kilica@musc.edu to learn more about how the Surgical Innovation Center can connect you with the appropriate resources.

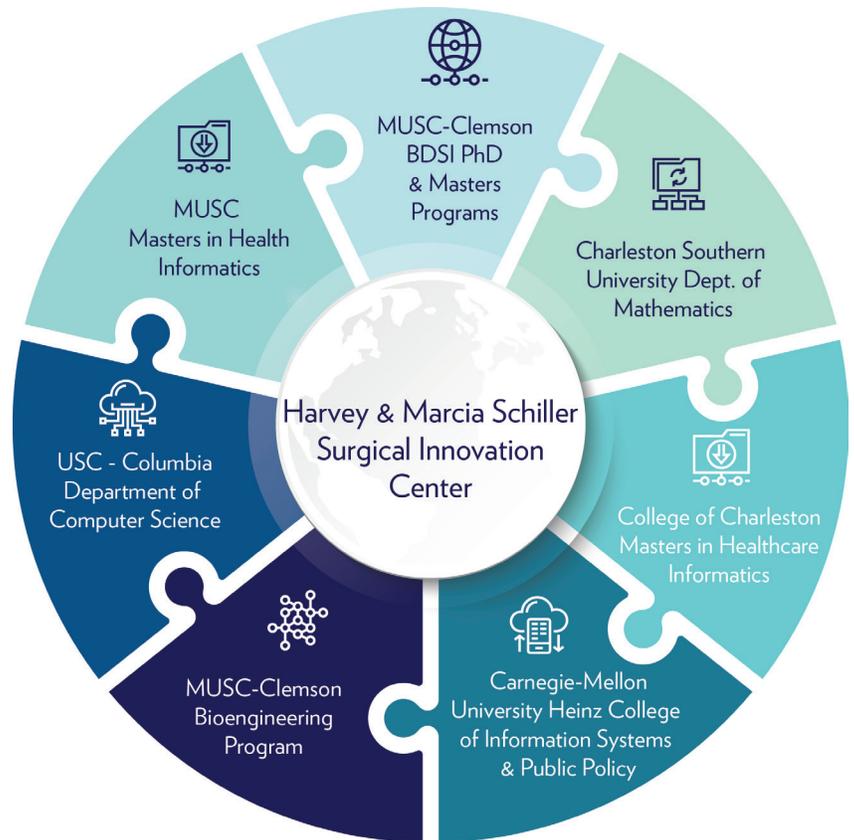


Inter-Institutional Collaboration

Our strength is in the collaborations we build. The Surgical Innovation Center is interested in collaborations and partnerships with educational institutions.

Since our inception, we have established collaborations with several educational institutions, particularly in the health informatics and bioengineering space, offering multiple pathways between faculty, students and programs.

The Center looks forward to the continued development and expansion of new and existing partnerships and educational endeavors.



Join Us!

The Surgical Innovation Center continues to actively look for new partnerships and collaborations within the following sectors:

- Data Science Managers
- Industry Leaders
- Healthcare Professionals
- Educational Institutions
- Bioengineering Professionals
- Medical Device Developers

If you are interested in partnering with us, please use the QR code to access and complete the web form, and a member of our AI Team will reach out to you!



Surgical Outcomes Research and Innovation Nucleus

The Surgical Outcomes Research and Innovation Nucleus (SORIN) was formalized in 2019 and serves to foster the development, testing and implementation of innovative therapeutic and health services interventions aimed at improving outcomes in patients undergoing surgery at MUSC.

The Department of Surgery has seen a steady increase in clinical trials over the past several years, with significant growth in industry-sponsored research and investigator-initiated clinical trials. We have a diverse and active portfolio that spans across most surgical disciplines housed within the Department of Surgery.

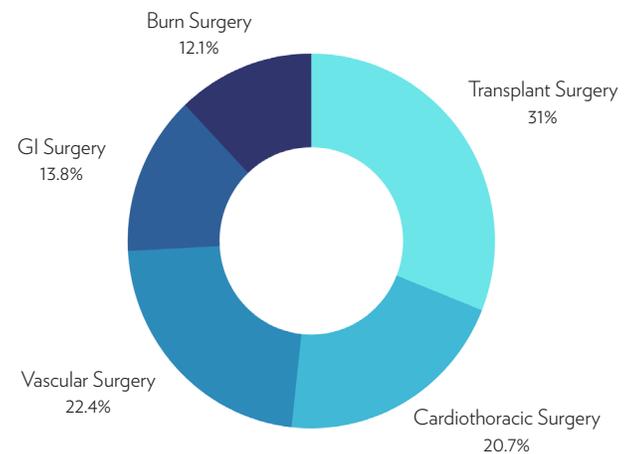
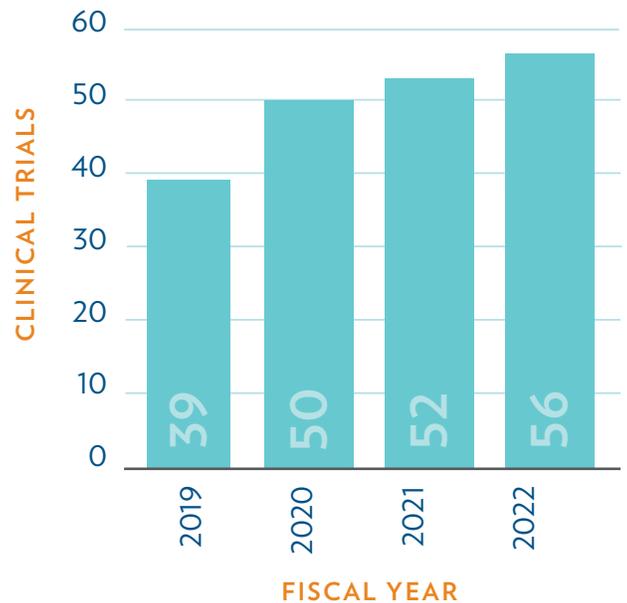
Who Do We Serve?

Our group has a proven track record of successfully conducting clinical trials across all divisions in the Department of Surgery.

Our staff is motivated, knowledgeable and eager to make clinical trials accessible to physicians and their patients.

How Can We Help?

We offer a full range of services from start to finish of your clinical trial. From trial feasibility assessment to study close-out, we can provide a detailed and comprehensive array of support to conduct your clinical trial in a safe and efficient manner. We also offer support in protocol development and post-trial publications for investigator-initiated, funded clinical trials.



Examples of a Number of Current, High-Impact Clinical Trials

Marc R. Katz, M.D., MPH <i>Cardiothoracic Surgeon</i>	SUMMIT Trial using Tendyne Mitral Valve System for the Treatment of Symptomatic Mitral Regurgitation
Steven Kahn, M.D. <i>Burn Surgeon</i>	DeepView SnapShot Portable (DV-SSP): Device Training Study Nexobrid treatment for partial and full thickness burns
Jean Marie Ruddy, M.D. <i>Vascular Surgeon</i> Anne Kroman, DO, Ph.D. <i>Cardiology</i>	BATwire - Percutaneous Implant Kit – Vascular Surgery & Cardiology
Prabhakar Baliga, M.D. <i>Transplant</i>	A 12-Month, Randomized, Open-Label, Phase IIA Study Evaluating the Safety and Efficacy of Siplizumab in Combination with Belatacept and MPA Compared to Standard of Care Immunosuppression in de novo Renal Transplant Recipients (ASCEND)
Ravi Veeraswamy, M.D. <i>Vascular Surgeon</i> Sanford Zeigler, M.D. <i>Cardiothoracic Surgeon</i>	TRIOMPHE Study, using the NEXUS Aortic Arch Stent Graft System specifically engineered for minimally-invasive total arch repair
Arman Kilic, M.D. <i>Cardiothoracic Surgeon</i>	OCS Heart Perfusion Post-Approval Registry (Transmedics, Inc.)
Aaron Leshner, M.D., MSCR <i>Pediatric Surgeon</i>	Telemedicine (TOBI) for pediatric burn patients
Thomas Curran, M.D., MPH <i>Colorectal Surgery</i>	Comparison of surgery and medicine in diverticulitis
Nancy Klauber-DeMore, M.D. <i>Surgical Oncology</i>	A window trial on Boswellia, an extract from Frankincense, for breast cancer primary tumors
Andrea Abbott, M.D., MSCR <i>Surgical Oncology</i>	Increasing socioeconomically disadvantaged patients' engagement in breast cancer surgery decision making through a shared decision making intervention

Meet the Leadership Team



David Taber, PharmD, MS
Director, SORIN



Morgan Overstreet, MS
Clinical Trials Manager

Our Services

We provide coordinator support for investigators conducting funded clinical research.

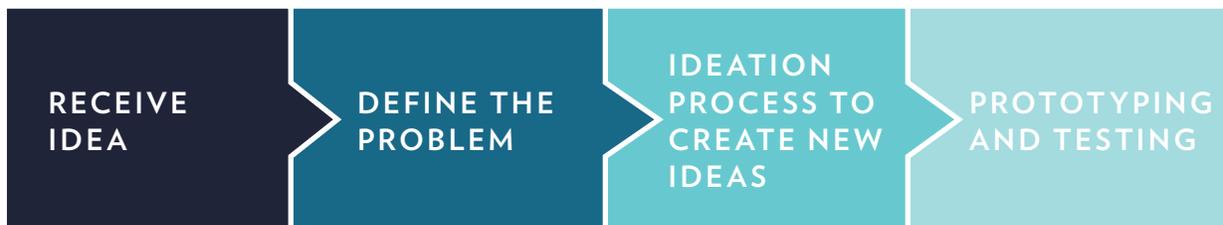
Please contact Clinical Trials Manager Morgan Overstreet, MS at overstm@muscc.edu to learn more about how the Surgical Innovation Center can connect you with the appropriate resources.

Human-Centered Design

The Human-Centered Design Program at MUSC creates novel solutions in the healthcare space to solve unmet medical need for users such as patients and physicians. The interdisciplinary HCD team leverages medical expertise, design experience, business acumen, and advanced technologies to iteratively problem solve.

What is Human-Centered Design Thinking?

For human-centered designers, there's always a story behind the innovation. That's because Human-Centered Design begins with the people you are designing for and finding a solution that fits their needs. The Design Thinking methodology uses empathy as a core value and generates opportunities to create innovative solutions through the ideation process that best fits the needs of the end users.



Who Do We Serve?

The Human-Centered Design (HCD) Program engages with department surgeons, researchers, and trainees to understand gaps & support device innovation through the utilization of HCD principles. The Program also trains surgical residents and medical students in design thinking, equipping them with the skillsets and tools to become medical innovators. Through collaboration with the Baker School of Business at the Citadel, the HCD Program aims to integrate business development into the innovation workflow at MUSC. Students and residents in the Program are challenged to identify unmet medical needs and to design novel solutions to satisfy those needs.

Meet the Leadership Team



Joshua Kim, MS
Program Director



David Mahvi, M.D.
Alice Ruth Folk Endowed
Chair in Clinical Oncology



Kristen Quinn, M.D.
MUSC Resident
HCD Champion

Our Services

We provide expertise in HCD thinking to support your innovative ideas.

Please contact Joshua Kim, MS at kimjos@musc.edu to learn more about how the Surgical Innovation Center can connect you with the appropriate resources.

HCD Programmatic Growth

The HCD program has continued to grow, with a new cohort of interdisciplinary MUSC graduate students and surgical residents each academic semester. Department of Surgery faculty mentorship is a cornerstone of the program. Students receive interprofessional credit hours for their participation and come from all MUSC graduate schools including the College of Medicine, Occupational Therapy, Physical Therapy, and Dentistry. These students have opportunities to shadow and engage with Department of Surgery faculty to better understand their perspective on the healthcare pain-point.

After conducting interviews with a variety of healthcare team members involved, including nursing, staff, patients, and providers, the team comes up with a solution. In collaboration with the Baker Business School at the Citadel, they learn how to make sure a solution is viable and sustainable from a business perspective and write a business plan and go-to-market strategy. At the conclusion of the semester-long interprofessional course, the entire cohort competes in a Pitch Day Shark-Tank-style competition.

Mentors and coaches include Joseph Scalea, M.D., Adam Tanius, M.D., MMSc, Bernice Huang, M.D., Kristen Quinn, M.D., Heather Evans, M.D. MS, and Konrad Rajab, M.D.

If you have an idea, a healthcare pain point, or just want to learn more, contact the HCD team:



Heartbeat Technologies



Startup Heartbeat Technologies has captured regional and national attention as they won the Southeastern Surgical Shark Tank Research Scholarship for \$5000 and were a Top three finalist in the SAGES Shark Tank for a \$40000 investment from the sharks. They have been featured in The General Surgery News and were a [2022 InnoVision Award Finalist](#) for best small enterprise in the state. They have raised almost \$150,000 over the past year to fund the research and development of the SAVER technology.

Glow Ink Solutions



Glow Ink Solutions (GIS) has amassed an interdisciplinary team of surgeons, residents, medical students, and financial analysts to commercialize Glow Dot. Patented in the USA and Europe, Glow Dot is a novel endoscopic tattoo aimed at improving tumor detection beyond the current standard of care.

Thank You

The establishment of the Harvey and Marcia Schiller Surgical Innovation Center is made possible through a generous gift from sports executive and retired U.S. Air Force Brigadier General Harvey Schiller and his wife, Marcia.

Our ability to facilitate the creation of both personalized treatment plans and usable and innovative products that make healthcare better and more efficient can only be made possible through the support of our partners and donors.

Because of you, we will transform how surgery is performed, improve clinical care, and decrease costs for patients in South Carolina and across the United States.

To learn more about how you can help change what's possible for patient care through supporting surgical innovation, contact Vera Ford, MBA, Development Director, at 843-792-1840 or fordva@musc.edu.