



# Focused Ultrasound Foundation

2021  
Year in Review

8

publications



12

webinars



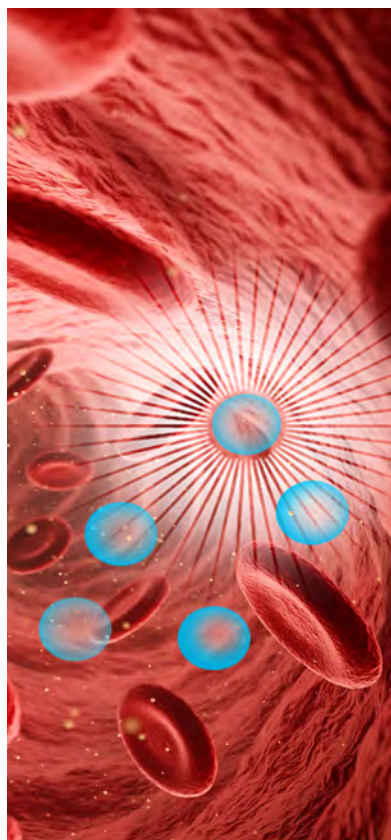
85

projects  
with results published  
cumulative



101

projects presented at  
scientific meetings  
cumulative



27

projects initiated



+7k

webinar views



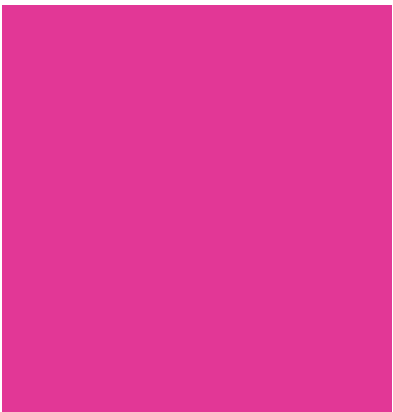


**15**  
years



## Celebrating 15 years of progress

While 2021 was another challenging year in the face of the pandemic, we have been astounded by the resiliency of the focused ultrasound community. Research continued at a blistering pace, and new clinical trials explored focused ultrasound treatment for patients with brain tumors, trigeminal neuralgia, neuropathic pain, liver tumors, and opioid addiction, among others. We also saw regulatory wins for Parkinson’s disease, desmoid tumors, and prostate diseases. In the world of reimbursement, focused ultrasound for essential tremor is now covered by Aetna—the first national insurance payor in the US—and the national governmental insurance in the UK. There were also positive coverage decisions for prostate disorders and histotripsy of liver tumors.

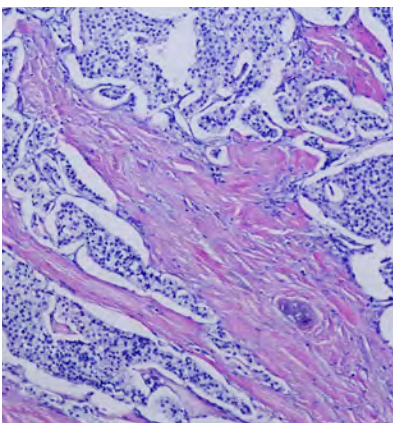


**123**  
projects completed  
cumulative

But, there is still much work to be done. As the field continues to push the envelope in translating innovative ideas into clinical research—with 160 or more indications currently in various stages of development—the Foundation’s role becomes increasingly important. This year we marked our 15th anniversary, and we humbly recognize that our success has been made possible solely by the generosity of our donors and friends. Thank you all for your continued support, and to everyone in the field for your dedication every day to the endgame of improving patients’ lives with focused ultrasound as soon as possible.

Be well.

Neal F. Kassell, MD



# creating knowledge research milestones ◀

## Research Awards Program

A crucial component of the Foundation's comprehensive research portfolio is our Research Awards Program, which funds millions of dollars toward clinical, preclinical, and technical projects in focused ultrasound. Our robust research efforts aim to develop new treatments and techniques that can advance to clinical (human) trials and ultimately improve the lives of patients around the globe—in the shortest time possible. ■

2021

**27**  
projects initiated

**8**  
projects completed

By the numbers

**123**  
projects completed

**101**  
projects with  
results presented at  
scientific meetings

**85**  
projects with  
results published

**69**  
projects with  
follow-on or co-funding

By the dollars

**\$13.6m**  
funding provided for  
completed projects

**\$68.6m**  
follow-on or co-funding

**7.95x**  
return on investment  
factor by which  
the Foundation leverages  
donor contributions

cumulative



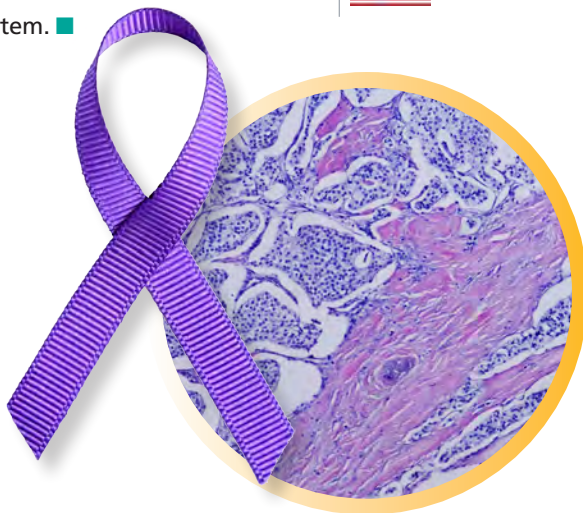
## preclinical studies

### “Proof of concept” studies

Important preclinical work last year included several “proof of concept” studies demonstrating hope on the horizon for treating brain tumor patients with focused ultrasound—as well as the expansion of various mechanisms of action for the technology to broaden applications for focused ultrasound and help more patients. ■

### Pancreatic cancer histotripsy

Researchers at **Virginia Tech** sought to determine whether ultrasound-guided histotripsy—a non-thermal method of using focused ultrasound to mechanically destroy tissue—could cause mouse models of pancreatic cancer to release more tumor antigens (immune-stimulating molecules) than other ablation modalities. The group found histotripsy to be a feasible modality for pancreatic cancer ablation and activation of the innate immune system. ■



### Gliomas immunotherapy delivery

Cancer immunotherapy, although effective for various types of cancer, has not yet been effective for gliomas. A research team at Washington University of St. Louis led by Hong Chen, PhD, used focused ultrasound to facilitate intranasal brain delivery in a mouse model, which allowed the administration of effective levels of immune checkpoint inhibitors to the brain. This new method enhanced the accumulation of the cancer immunotherapy by approximately four-fold. ■



### Brain histotripsy a new system


A research team at the **University of Michigan** designed and tested a transcranial, magnetic resonance (MR)-guided histotripsy system for use in various brain surgery applications. Results of the large animal study showed well-confined lesions within the targeted volume and no bleeding or edema outside the ablation zones. ■



### Aducanumab improves memory

Jürgen Götz’s group at the University of Queensland published two preclinical studies using focused ultrasound and aducanumab—the first drug approved for Alzheimer’s disease (AD) in the US in 20 years. The small animal aging study found low-intensity ultrasound could restore memory and cognition. ■



 This icon represents projects that are partially or fully funded by the Foundation.

## technical projects

### Collaborations

2021 saw many in the community coming together to collaborate on studies, projects, and partnerships to collectively advance the field and share knowledge. ■



### Open-source data sharing

To facilitate improved patient outcomes and faster treatments the Foundation established a **Kranion® user group** that connects monthly to network, share experiences, and collaborate.

Kranion® is a freely available, open-source focused ultrasound treatment planning and simulation tool for the use of the entire community.

Approximately 40 sites worldwide are using it for skull density ratio calculation for patient selection, post procedure review, skull phase aberration correction research, and more. Anyone interested in learning more about Kranion® and connecting with other users is welcome to join. ■



▲ Sites across the globe using Kranion®

### Open access research repository

The Foundation and the **Center for Open Science** announced the creation of the **Focused Ultrasound Foundation Collection**, an open access research data repository where researchers can work transparently and comply with open science policies, browse existing data and materials, build on findings, and contribute their own work to the growing collection of rigorous scholarship from the field. The new data repository is an important step toward the Foundation's mission of accelerating scientific discovery by launching a body of scholarship dedicated to open and transparent sharing of data, outputs, study materials, and more. ■



## clinical trials

### Highlights

Multiple large-scale, multi-center, collaborative trials are advancing the technology for Parkinson's disease, glioblastoma, bone pain from cancer, and uterine fibroids—adding to the growing body of evidence confirming the validity of focused ultrasound to treat a host of serious diseases and moving the technology from bench to bedside. ■

### Glioblastoma

The first patient was treated in a multi-center clinical trial using focused ultrasound to open the blood-brain barrier (BBB) in glioblastoma patients undergoing standard chemotherapy treatment. This study is expanding the scope of treatment for primary brain tumor patients and paving the way for larger clinical trials.

Researchers at the **University of Virginia (UVA)** hope that disrupting the BBB will enhance the delivery of chemotherapy to the tumor site. The Foundation is contributing to this clinical trial through an ongoing partnership with the UVA Focused Ultrasound Center of Excellence. Eighteen of 20 patients have been treated overall. ■



### Uterine fibroids

The first patients were treated in the Netherlands in a clinical trial comparing common treatments for uterine fibroids with focused ultrasound therapy. Participants in the MYCHOICE clinical trial are being randomly selected for each therapy and have a 2:1 chance of receiving focused ultrasound. ■



### Bone pain from cancer

A prospective, multi-center, three-armed randomized controlled trial for alleviating pain from bone metastases in cancer patients is underway at seven hospitals in four European countries—Netherlands, Finland, Germany, and Italy. University Medical Center Utrecht, a Focused Ultrasound Center of Excellence, is the coordinating center for the trial, in which 216 patients will receive one of three proven treatments, including focused ultrasound. ■



### US FDA approval Parkinson's disease

The US Food and Drug Administration (FDA) expanded approval of Insightec's Exablate Neuro focused ultrasound device to include patients with advanced Parkinson's disease (PD) suffering from mobility, rigidity, or dyskinesia symptoms.

The decision was based on a multi-site pivotal clinical trial in which clinicians used focused ultrasound to successfully ablate an area of the brain called the internal portion of the globus pallidus, a proven neurosurgical target for treating features of PD such as mobility, rigidity, or involuntary movements. Trial results have not yet been published; however, data from the preliminary clinical trial—funded by the Foundation, The Michael J. Fox Foundation for Parkinson's Research, and Insightec—were published in the *Journal of Neurosurgery*. ■





# clinical trials

## 2021 publications

The global adoption of focused ultrasound relies on the researchers who are advancing the technology beyond its known limits. Completed and published data last year includes eight articles. ■

### 1 Glioblastoma

*Journal of Neuro-Oncology*

In a world-first trial, researchers from **Sunnybrook Health Sciences Centre**, Sunnybrook Research Institute, and the University of Toronto used liquid biopsy to test the ability of focused ultrasound to enhance brain tumor biomarker detection from a routine blood sample in GBM patients. This trial demonstrates the movement of focused ultrasound from therapy to diagnostics. ■



# 1

### 2 Low back pain

*Pain Medicine*

**FUSMobile**, a company developing a focused ultrasound platform for neural tissue ablation, published results from its first clinical trial for the treatment of low back pain; the study enrolled 10 participants, who reported no significant device- or procedure-related adverse events. ■



# 2

### 4 Knee pain

*International Journal of Hyperthermia*

Researchers in Japan used focused ultrasound to treat patients with knee pain secondary to chronic osteoarthritis; most participants (73.7%) had significant reductions in pain in the 12 months following treatment. ■



# 4

### 3 Histotripsy

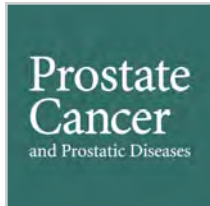
*IEEE Transactions on UFFC*

The “Histotripsy: Approaches, Mechanisms, Hardware, and Applications” special issue of *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control* explored histotripsy for liver tumors; blood clot degradation; urinary tract infections; immune system activation; and abdominal, brain, and tendon treatments. ■



# 3





## Prostate cancer **5**

*Nature's Prostate Cancer and Prostatic Diseases*

In two studies demonstrating the durability of focused ultrasound for prostate cancer, researchers at **Imperial College London** compared outcome data between patients receiving focal therapy versus radical prostatectomy and found them to be similar for up to eight years. ■



## Prostate cancer **6**

*Radiology*

A trial investigating focused ultrasound for focal ablation of the prostate was conducted at various sites in Toronto; 93% of patients with intermediate risk disease who received transrectal focal ablation under MR guidance had no clinically significant prostate cancer five months after treatment. ■



## Brain **7**

*Essential tremor and Parkinson's disease*

In a study from **Brigham and Women's Hospital** comparing treatment parameters, lesion characteristics, adverse events, and outcomes in 123 cases of MR-guided focused ultrasound thalamotomy in ET and PD patients, results confirmed the efficacy of focused ultrasound. ■



## Special report **8**

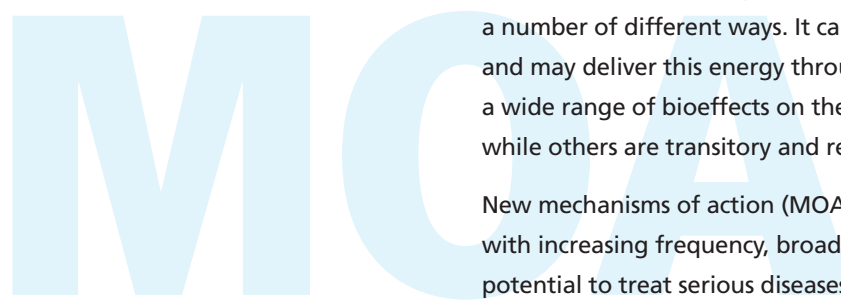
*Essential tremor and Parkinson's disease*

*Nature Communications'* special report, "From Brain to Behaviour," highlighted the most exciting brain research of 2021 and included focused ultrasound research on transcranial neuromodulation. ■

# news

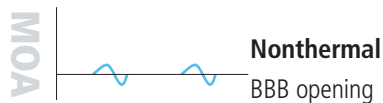
# clinical trials

## Mechanisms of Action expand for focused ultrasound



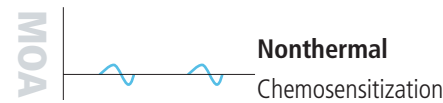
Focused ultrasound is a platform technology that can interact with the body in a number of different ways. It can produce both mechanical and thermal energy and may deliver this energy through either high or low pressure waves—inducing a wide range of bioeffects on the treated tissue. Some effects are permanent, while others are transitory and reversible.

New mechanisms of action (MOA) for focused ultrasound are being discovered with increasing frequency, broadening our understanding of the technology’s potential to treat serious diseases and conditions.



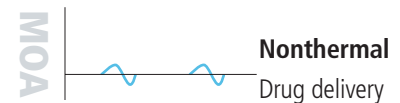
### Brain metastases a world-first trial

Researchers at **Sunnybrook Health Sciences Centre** in Toronto, Canada, demonstrated that MR-guided focused ultrasound can safely deliver antibody therapy to breast cancer that has metastasized to the brain. The team captured images of trastuzumab, or Herceptin, precisely targeting tumors in the brain after opening the BBB with focused ultrasound and enabling intravenous trastuzumab to more effectively access tumor sites. Results from the ground-breaking trial, published in *Science Translational Medicine*, indicated that patients experienced a decrease in tumor size of breast cancer metastases in the brain. ■



### Pancreatic cancer Korean trial

Clinicians at **Seoul National University Hospital** are using low power, mechanical, effects of focused ultrasound on pancreatic cancer lesions to try to enhance the effectiveness of a common chemotherapy regimen, FOLFIRINOX. To date, 23 of 30 patients have been treated. The hope is that the treatment will help disrupt the dense tumor stroma to allow better penetration and effectiveness of the drugs. ■







### Pancreatic cancer enhanced chemotherapy

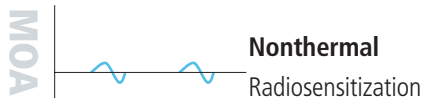
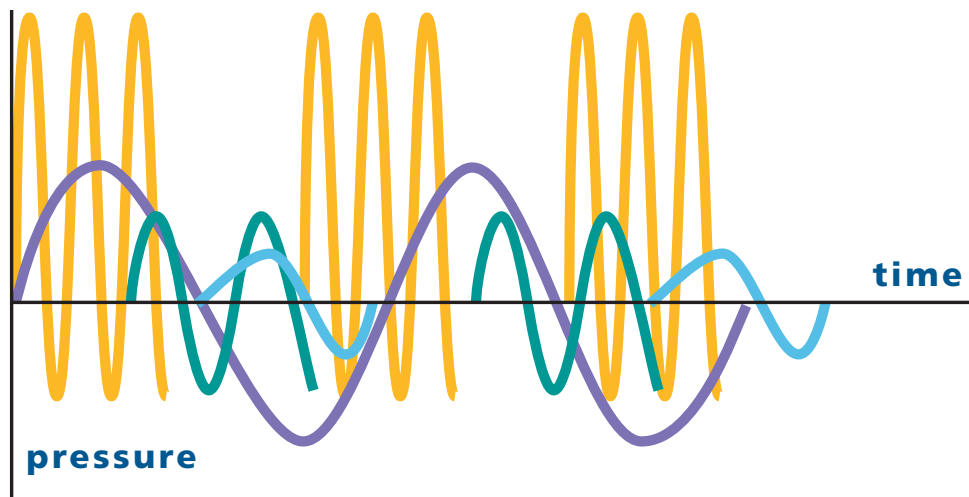
The **University of Oxford** began a Phase I study investigating heat-activated chemotherapy plus hyperthermia, triggered by focused ultrasound in patients with pancreatic cancer. The PanDox study uses Celsion Corporation’s ThermoDox®, a proprietary heat-activated liposomal encapsulation of the chemotherapy drug doxorubicin. Researchers are comparing ThermoDox® plus focused ultrasound to enhance delivery of the drug in unresectable pancreatic tumors versus systemic delivery of free doxorubicin. ■



# creating knowledge research milestones

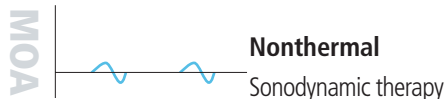
## Sound waves

-  Histotripsy
-  Hyperthermia
-  Nonthermal
-  Thermal ablation



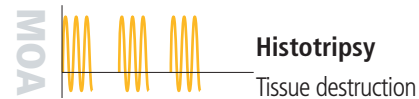
## NaviFUS trial to enhance radiotherapy

A clinical trial in **Taiwan** combining focused ultrasound and radiotherapy in patients with primary brain tumors launched in September. Studies suggest that opening the BBB to enhance oxygenation of brain tissue could make radiotherapy more effective. ■



## Glioma first patient enrolled

A clinical trial at the **Ivy Brain Tumor Center** at Barrow Neurological Institute in Phoenix, Arizona, is investigating the use of focused ultrasound to treat patients with recurrent GBM and other high-grade gliomas. Researchers are exploring sonodynamic therapy—using focused ultrasound to activate a drug to cause cell death only in the tumor—in these patients. After dosing three of the 30 patients, the team noted the method was well-tolerated and safe. The Foundation did not fund this study. ■



## Liver tumors trial update

HistoSonics is investigating the safety and efficacy of using the company's new platform—a sonic beam therapy platform utilizing histotripsy—to noninvasively and mechanically destroy liver tumors. Two large ongoing clinical trials, both called #HOPE4LIVER, are seeking patients at eight sites in the US and five in Europe. The platform used in both trials was granted **Breakthrough Device Designation** by the FDA in October. ■



## clinical trials

### Key firsts

Two important brain projects began last year that highlight the shift from preclinical studies to clinical trials. The Foundation considers the brain to be the vanguard target for focused ultrasound. ■

### Opioid use disorder explored

Researchers at **West Virginia University** began a first-in-world clinical trial investigating focused ultrasound to address opioid use disorder. The trial aims to reduce patients' substance cravings and addictive behaviors.

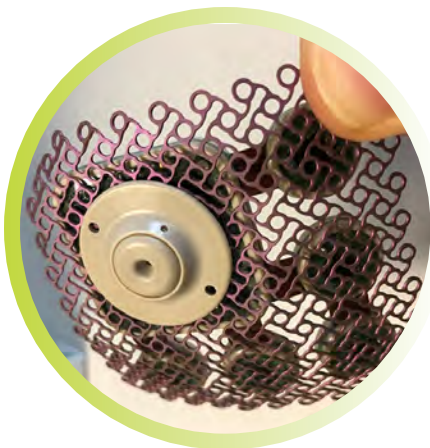
COVID-19 has intensified the addiction crisis worldwide, and researchers hope to be able to offer patients a new treatment option. ■



### CarThera launches glioblastoma trial

The first patient was treated in a new phase I/II clinical trial for patients with recurrent GBM. After surgical removal of the tumor, participants in this trial have the SonoCloud-9 device, by French manufacturer CarThera, implanted to temporarily open the BBB prior to the administration of chemotherapy.

The trial at **Northwestern University** in Chicago is the first for CarThera in the US and is a significant step in developing the technology to treat a wide range of brain diseases. ■



CarThera's SonoCloud-9 device for treating glioblastoma

### What next?

#### A mainstream treatment

The dialogue has shifted from "if" focused ultrasound will have a critical role in mainstream therapy to "when." Foundation Chairman Neal F. Kassell, MD, explains in a recent blog the progress that must be achieved in five key areas to reach this goal as soon as possible:

- 1 evidence
- 2 awareness
- 3 capital
- 4 partners
- 5 businesses

The vision is that by 2035:

**+1M** patients will be treated each year at

**10,000** facilities for focused ultrasound

▲ Check out the blog on our website to learn how we can band together and take risks to cross the finish line, improving the lives of millions of people around the world.



# indication spotlight

## Essential tremor celebrates 10 years

In February 2011, Jeff Elias, MD, and his team at UVA treated the first ET patient to receive focused ultrasound in North America. This event—made possible by a partnership between UVA, the Foundation, and manufacturer InSightec—ignited a sea change in therapy including FDA approval in July 2016 for focused ultrasound treatment of ET. In 2021, 10 years later:

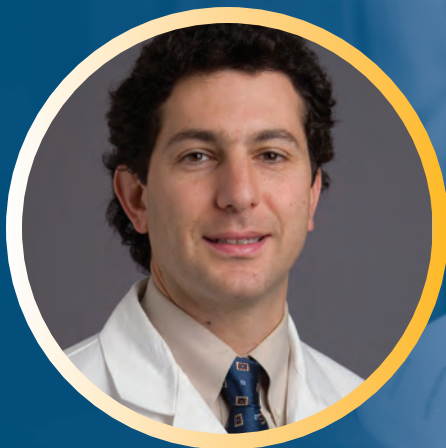
- **Worldwide**—more than 6,000 ET, and Tremor-dominant PD, patients have been treated. More than 100 treatment centers now offer focused ultrasound for ET.
- **In the US**—Medicare covers the procedure in all states and the first national insurance payer began reimbursing the treatment.

### • 2021 research highlights

A meta-analysis of nearly 400 ET patients, which found sustained, long-term efficacy for focused ultrasound treatment at 48 months and beyond.

Focused ultrasound for ET reached a new milestone, progressing to bilateral (both sides of the brain) studies.

A clinical trial by a research team in Germany, Switzerland, and Spain, led by José Obeso, MD, demonstrated the feasibility of staged, bilateral treatment. To date, most focused ultrasound treatments for ET only address the patient's dominant side. Additional studies are planned. ■



◀ Jeff Elias, MD  
Professor of Neurological Surgery, UVA

## workshops

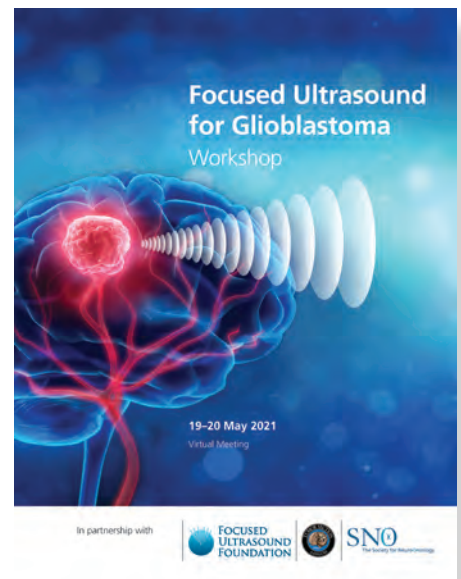
### Summary

The Foundation sponsors workshops throughout the year addressing key challenges and opportunities for the technology. These meetings seek to foster collaborations and partnerships among critical stakeholders while serving as a forum for exchanging knowledge and ideas to drive innovation, and creating roadmaps for the progression of focused ultrasound. The Foundation hosted four such workshops in 2021; white papers and/or video archives of the presentations from the events below are available on our website. ■

### Glioblastoma

This two-day virtual workshop, in partnership with the Society for Neuro-oncology and the AANS/CNS Tumor Section, examined focused ultrasound for GBM, including the latest research on BBB opening, immunotherapy, and sonodynamic therapy. Expert panelists discussed important questions such as which GBM patient populations have the most critical unmet need; which chemotherapeutic agents to investigate in upcoming clinical trials; and regulatory and reimbursement considerations. Priority research questions were identified including:

1. what are the best methods to quantify drug delivery following BBB opening;
2. should there be a focused ultrasound specific microbubble; and
3. how should focused ultrasound enhanced liquid biopsy be incorporated into the diagnosis/ treatment monitoring pathways for GBM? ■





▶ A white paper summarizing the workshop's proceedings is also available online.

◀ A video archive of the presentations is available on our website.



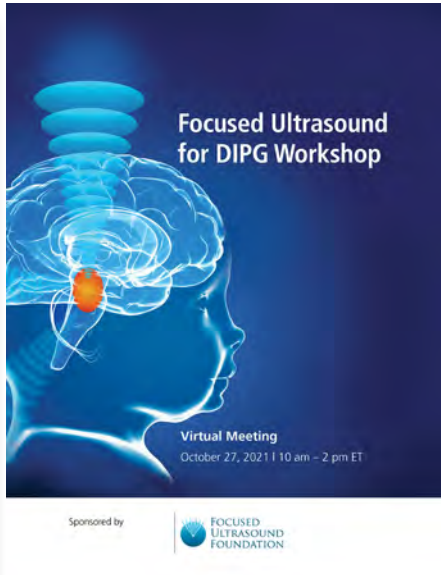


White paper   
 Presentation videos 

## Cancer immunotherapy

The Foundation partnered with the Cancer Research Institute for its fourth workshop addressing the role of focused ultrasound for immune-based treatment of cancer. Participants agreed on several goals, including the need for a Foundation-hosted central data analysis and storage hub to promote cross-study comparisons and communication within the community. Funding was recommended to support:

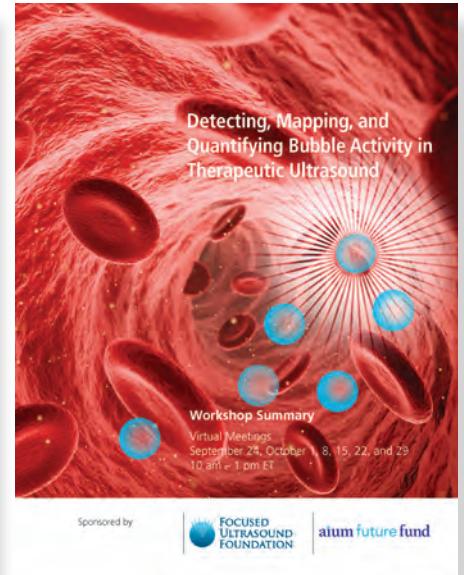
1. preclinical projects that address focused ultrasound's effects on the tumor vasculature or partial versus total ablation outcomes, and
2. clinical "window-of-opportunity" trials combining focused ultrasound with an immunotherapeutic. ■



Presentation videos 

## Diffuse intrinsic pontine glioma

This virtual workshop convened critical stakeholders in pediatric cancer care and focused ultrasound to discuss how to best advance focused ultrasound as an adjunctive treatment for Diffuse Intrinsic Pontine Glioma (DIPG). DIPGs are highly aggressive brain tumors that affect young children, and the current therapies are highly ineffective—only 10 percent of children survive two years after diagnosis. As a result of this workshop, preclinical and clinical working groups have been established to explore the most safe, efficient, and effective solutions to combinatorial focused ultrasound treatments for DIPG. ■



Presentation videos 

## Bubble activity detect, map, quantify

In partnership with the American Institute of Ultrasound in Medicine's Future Fund, a virtual workshop series on "Detecting, Mapping, and Quantifying Bubble Activity in Therapeutic Ultrasound" took place this Fall to explore bubble activity dosimetry for ultrasound therapy. The group concluded that monitoring, controlling, and mapping of cavitation will be extremely important for therapeutic modalities involving ultrasound bubbles. Workshop participants agreed on major goals moving forward including the publication of a consensus paper to identify the current needs and challenges, and the establishment of working groups to develop guidelines. ■

## fellows & interns

### Supporting clinicians and scientists

The Foundation is dedicated to cultivating the next generation of focused ultrasound clinicians and scientists through our fellowships and various internship opportunities. We also are committed to promoting a culture within the field that values equity, diversity, and inclusion. This effort includes attracting researchers, students, and others from underrepresented groups to the focused ultrasound community, and uniting, supporting, and advancing women and minority allies within the community locally and abroad. ■



▲ Samia Taliaferro, Foundation summer 2021 intern, is interested in advocating for women's health.

### Summer intern program

The Foundation was proud to host an intern for the first time as part of the Economic Club of Washington, DC's 2021 summer internship program.

Now in its seventh year, the program allows scholars, like Samia Taliaferro, to gain real life work experience, professional development, and financial support to offset college expenses.

The Foundation joined an impressive list of international companies to provide 35 internship experiences for Economic Club scholars. ■

THE ECONOMIC CLUB  
OF WASHINGTON, D. C.



### Internship program celebrates a decade

As part of the 10th year of our summer internship program, the Foundation accepted a record 15 students and recent graduates. Projects ranged from a technical nature—such as analyzing ultrasound wave behavior in a real-world application; constructing computer-based models for treatment planning; and simulating focused ultrasound procedures to improve patient care—to research, advocacy, and communications. ■

▶ The Foundation's summer technical internships are generously funded by the Claude Moore Charitable Foundation.



## spotlight



### Elisa Konofagou, PhD

Focused ultrasound pioneer Elisa Konofagou, PhD, was inducted into the National Academy of Medicine (NAM). She is the Robert and Margaret Hariri Professor of Biomedical Engineering and Professor of Radiology at Columbia University; she also directs the University's Ultrasound and Elasticity Imaging Laboratory, where her research addresses drug delivery, breast cancer treatment, and neuromodulation. The NAM cited Dr. Konofagou's "leadership and innovation in ultrasound" and other applications in the "clinical management of health care problems such as cardiovascular, neurodegenerative diseases, and oncological diseases."

Dr. Konofagou will also serve as honorary president of the 8th International Symposium on Focused Ultrasound, October 23–28, 2022. ■

### Jessica Foley, PhD

Foundation Chief Scientific Officer Jessica Foley, PhD, was elected to the Board of Directors of the VA Biotechnology Association, which advocates for its 250+ device industry and biopharmaceutical members.

She also presented "Focused Ultrasound at the Tipping Point" at a VA Bioscience Commercialization Luncheon, sharing the state of the field and the Foundation's strategy for advancing the technology.

Dr. Foley is also spearheading the Foundation's Women in Focused Ultrasound effort, including moderating a panel discussion with focused ultrasound women leaders about ensuring the field's equity and diversity. ■



### Natasha Sheybani, PhD

Former Foundation Senior Scientist Natasha Sheybani, PhD, was selected for an NIH Director's Early Independence Award, which supports scientists pursuing innovative research that has the potential for a broad impact in biomedical, behavioral, or social sciences. The award enables junior scientists to bypass the postdoctoral training period to launch an independent research career.

Dr. Sheybani is now an assistant professor in the Department of Biomedical Engineering at UVA where she will continue advancing noninvasive precision immunotherapy in solid cancers. She was also named this year to the Forbes "30 Under 30" list. ■

# regulatory approvals

## Highlights

Focused ultrasound device manufacturers continued to expand their geographic footprint of regulatory approvals, increasing the number of countries in which focused ultrasound procedures are available to patients. ■

**28**  
New approvals

**42**  
Countries  
New approvals expand availability of focused ultrasound.

**3**  
Companies  
New approvals for Profound Medical, Insightec, and Shenzhen Pro-HITU increase patient access.

### Belarus | MOH



Essential tremor  
Parkinson's tremor

### Kuwait | MOH FDCC



Bone metastases  
Uterine fibroids

### China | NMPA



Essential tremor  
Parkinson's tremor

### Peru | DIGEMED



Essential tremor  
Neuropathic pain  
Parkinson's tremor

### Columbia | INVIMA



Essential tremor  
Neuropathic pain  
Parkinson's tremor

### Saudi Arabia | NMPA



Bone metastases  
Uterine fibroids

### Europe | CE Mark



Desmoid tumors  
Uterine fibroids  
*Applies to 33 countries*

### Singapore | HSA



Bone metastases  
Essential tremor  
Osteoid osteoma  
Parkinson's tremor  
Uterine fibroids

### India | CDSCO



Essential tremor  
Neuropathic pain  
Parkinson's tremor

### United States | FDA



Parkinson's disease, dyskinesia  
Prostate disorders

## reimbursement

### Expanded coverage

Focused ultrasound saw several new wins in reimbursement but there is still much work to be done. Moving forward, the Foundation will be putting more resources than ever toward reimbursement efforts, as the technology cannot achieve widespread adoption and access if it is not supported by the insurance industry. ■



### United States advances

#### Parkinson's disease

**19** states now

cover focused ultrasound treatment for tremor-dominant PD under Medicare. The Centers for Medicare and Medicaid Services (CMS) expanded this coverage.

#### Liver cancer

**AMA** HistoSonic announced that the American Medical Association issued a new Current Procedural Terminology (CPT®) code for histotripsy of the liver.

**\$12,500**

facility procedural payment level set by CMS for histotripsy of liver tumors.

#### Essential tremor

**1st** national US insurance payer,

Aetna, covers focused ultrasound for medication-refractory ET.

### Breakthrough Devices Program

In 2018, the US FDA established the Breakthrough Devices Program (BDP), which allows for fast-tracking approvals including device-led combination products for focused ultrasound. The goal of the program is to expedite patient access to more effective treatment or diagnosis through a more rapid assessment and review process. Several focused ultrasound companies have received this designation.

Manufacturers can participate in the BDP if their device meets certain criteria. It must provide a more effective treatment for a life threatening or debilitating disease or condition than current standard of care.

The program represents third party validation by the FDA of the importance of the diseases that focused ultrasound companies are pursuing and the need for accelerating the timeline to regulatory approval. ■

### Around the world

**100+** treatment centers around the world now offer focused ultrasound for essential tremor.

**6,000+** patients have been treated to date for ET.

# industry investments

## Capital raised

We are closer than ever before to the widespread adoption of focused ultrasound technology. The field is exploding, as evidenced by the millions raised by multiple focused ultrasound companies. Two early-stage investors made an investment in a second focused ultrasound company, signaling confidence in the technology. ■

2021

**\$397<sup>m</sup>**  
raised by

**13**  
companies

Plus

**2**

early-stage institutional investors  
making a second investment

## 2021 investments

Company	Amount   \$M
Acoustiic INC	\$0.2
Acoustiic INC	\$1.3
Acoustiic INC	\$3.7
Alpheus Medical INC	\$16.0
Cordance Medical INC	\$1.0
EDAP TMS SA	\$28.0
EXACT Therapeutics AS	\$0.8
Exo Imaging INC	\$220.0
IMGT CO, LTD	\$12.9
Microvascular Therapeutics LLC	\$0.6
OrthoSon LTD	\$6.8
SecondWave Systems INC	\$4.0
Shende Medical Equipment Technology CO, LTD	\$15.7
Sonablate CORP	\$70.0
SonoVol INC	\$0.1
Vensica Medical	\$16.0
<b>Total</b>	<b>\$397.1</b>



# FUS Partners

## Industry support

The Foundation's FUS Partners program works tirelessly to support the FUS industry. With nearly 75 individual introductions in 2021, the team vigorously supports investment in the community, accelerates mutually beneficial cooperation, and facilitates the technology transfer of IP to industry. ■



## FUS Partners introductions

23

Company to investor



24

Company to company



25

Tech Transfer



# webinars

## Thousands reached

The Foundation continues to host seminars, giving experts in the field an opportunity to present on areas of emerging interest or promising research. The talks are broadcast via webinar to help keep the broader community abreast of new advances. ■

12  
Webinar titles

- Picture a Scientist
- UMC Utrecht COE Ceremony
- Focused Ultrasound for Pediatrics Fireside Chat
- Neuroethics for Novel Neurotechnologies
- Parkinson's Disease Fireside Chat
- Cancer Immunotherapy Fireside Chat
- Noninvasive HIFU Treatment of Varicose Veins  
*European Experience and US Market Perspective*
- Pathway to Getting Paid for a New Medical Technology in the US
- Team Building De-Mystified  
*Strategies and Tactics for Finding and Keeping Great People*
- Novel Advances in Breast Cancer Treatment
- Indication Selection Through the Eyes of an Investor  
*A Conversation with RA Capital*
- Expanding the Horizon  
*Focused Ultrasound and Medication-Refractory Epilepsy*

Access webinars on our website ▲  
for viewing on our YouTube channel.



## 2021 stats

7,100  
views

30+  
presenters

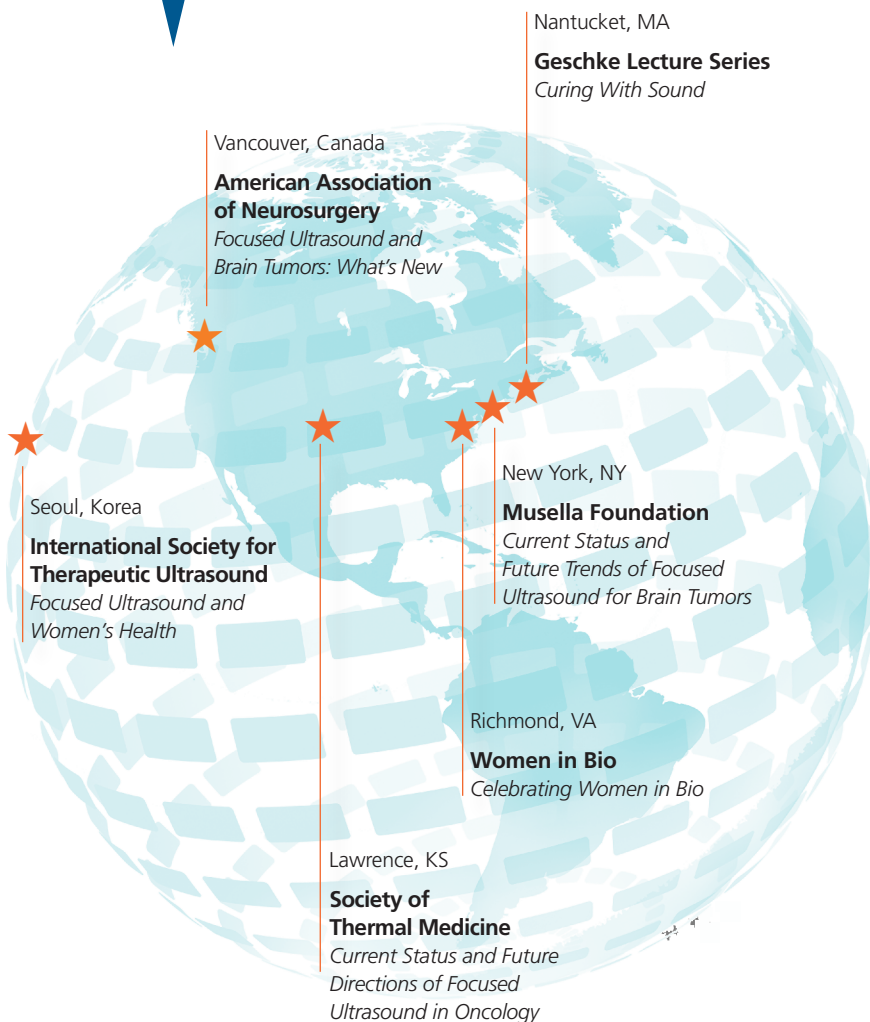
5  
indications

3  
commercialization topics

# meetings & lectures

## Disseminating knowledge

Foundation staff shared focused ultrasound at important scientific and clinical meetings around the globe in 2021; participation at other venues helped raise awareness among the general population. ■



## 100,000 reached by lecture

Best-selling novelist and Foundation Board member John Grisham paired with Foundation Chairman Neal F. Kassell, MD, for a conversation about focused ultrasound as part of the Nantucket Atheneum's Geschke Lecture Series. The lively event was moderated by Jane Metcalfe, founder and CEO of NEO.LIFE and a Foundation Council member.

The virtual discussion reached more than 100,000 people through social media. The Geschke Lecture Series is funded by a National Endowment for the Humanities Challenge grant and a large donation from the Geschke Foundation. ■

## council

**“ I am passionate about advancing the development, delivery, and deployment of transformational technologies with the potential to save or improve lives.”-**

— Freda Lewis-Hall

**“ The current trajectory of this important field of medicine is exciting, as focused ultrasound has the potential to become the standard of care for so many health indications.”**

— Sona Wang

**“ Focused ultrasound was the subject of my research doctorate, and I have been keenly watching the development of this field ever since.”**

— Rowland Illing

## 7 New members

The Foundation was pleased to welcome seven new members this year to our Council, a valued group of goodwill ambassadors who provide strategic advice, assist with raising funds, and help build awareness of focused ultrasound. ■

**Freda Lewis-Hall, MD, DFAPA, MFPM**, has spent more than 40 years on the frontlines of healthcare as a clinician, researcher, and leader in the biopharmaceuticals and life sciences industries, most recently as a top executive at Pfizer, Inc. “I am passionate about advancing the development, delivery, and deployment of transformational technologies with the potential to save or improve lives,” said Dr. Lewis-Hall. “I believe focused ultrasound to be such a technology.”

▶ Other new members Bob Hugin, Marc Onetto, Carolyn Yeh, and Mary Lou Jepsen were profiled earlier this year in our 2021 Midyear Report, which can be found on our website.

**Sona Wang** has more than 30 years of institutional venture investment experience. Since 1988, she has co-founded and managed three venture capital funds, and was previously an investment manager with Allstate Insurance Company’s Venture Capital Division, one of the oldest institutional venture funds in the US. “I have been following the development of focused ultrasound technology with keen interest for the last ten years,” said Ms. Wang. “The current trajectory of this important field of medicine is exciting, as focused ultrasound has the potential to become the standard of care for so many health indications.”

**Rowland Illing, DM, MRCS, FRCR**, serves as Chief Medical Officer and Director of Public Sector Health International for Amazon Web Services. Trained as an interventional radiologist, Dr. Illing treated patients with focused ultrasound during his medical career. “Focused ultrasound was the subject of my research doctorate, and I have been keenly watching the development of this field ever since. I am delighted with the clinical impact this technology is making and the key role the Foundation has in bringing together all of the stakeholders, raising awareness, and supporting research,” he said. ■



## donor spotlight

### **Ellie Block** children's health champion

Ellie Block, generous donor and Foundation Council member with a lifelong passion for addressing critical issues affecting children and families, has long supported focused ultrasound. Her interest in innovative approaches in pediatrics and family medicine—including major gifts instrumental in the development of top children's hospitals in New York, Chicago, and Providence, Rhode Island—contributed to her funding the first focused ultrasound pediatric pilot trial for osteoid osteoma (painful benign bone tumors) in 2014. That trial laid the groundwork for the first US regulatory approval for the technology to directly impact pediatric patients a mere five years later.

In 2021, Ellie again began funding critical focused ultrasound research for children via a first-in-human trial for childhood brain cancer. Thanks to her generosity, this past summer researchers at Columbia University began a clinical trial using focused ultrasound to facilitate the delivery of chemotherapy to progressive DIPGs—a devastating, malignant, highly aggressive type of brain tumor that affects children around the age of five. ■



## new programs

“The Foundation is extremely grateful to the Smith family for their leadership and vision in recognizing the promise of focused ultrasound. With their help, we can help advance this game-changing approach to treating neurodegenerative disorders.”

— Neal F. Kassell, MD  
Chairman  
Focused Ultrasound Foundation

### Fund established

The Eddie and Jo Allison Smith Foundation Fund for Focused Ultrasound Treatment of Neurodegenerative Disorders was established through the generosity of Eddie Smith and his family.

This fund will support research for disorders such as Alzheimer’s disease, Parkinson’s disease, ALS, and Huntington’s—helping to fund an ever-growing pipeline of studies and trials around the world to build upon the substantial body of evidence demonstrating the use of focused ultrasound for neurodegenerative disorders. ■

▶ Eddie Smith



▲ Read more about the establishment of the fellowship by a longtime supporting family on our website.

### Andrew J. Lockhart Postdoctoral Fellowship

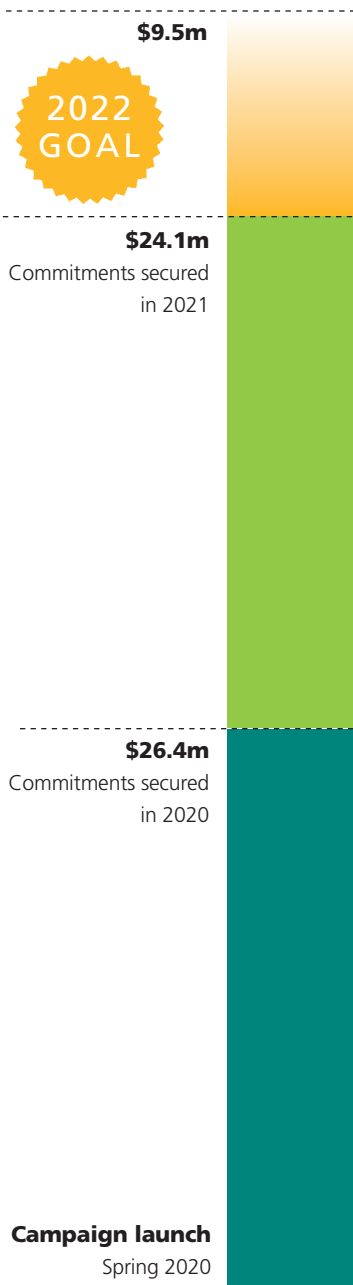
Caitlin Tydings, MD, is the program’s inaugural fellow; at Children’s National Hospital, Dr. Tydings is developing focused ultrasound as an immune modulator in pediatric cancers.

A one-year fellowship, the Andrew J. Lockhart Postdoctoral Fellowship

in Focused Ultrasound and Immuno-Oncology, is designed for early-career researchers as a way for the Foundation to cultivate the next generation of investigators who could advance the development and adoption of focused ultrasound in immuno-oncology. ■

## supporting our goals

**\$60 million**  
support for research & activities



### Campaign 2021

The Foundation has secured \$50.5 million to date against our \$60M campaign which was launched in April of 2020.

This campaign will create the long-term financial stability required to implement our strategic priorities in neurological conditions, psychiatric disorders, and cancer and cancer immunotherapy. ■

### Foundation budget 2021

The Foundation's budget for 2022 is \$15 million, of which 65% is dedicated to research. To support the Foundation's wide variety of activities, the fundraising goal for 2022 is \$8 million in cash and \$7 million in pledges to be paid in future years. ■

### Please donate

Help us as we work to improve the lives of millions of people with serious medical disorders.

Thanks to our donors, the field of focused ultrasound is evolving at an accelerated pace, and the technology has the potential to become the standard of care for a variety of diseases and conditions, thus reducing death, disability, and suffering for countless patients.

Join us as we work to provide a noninvasive alternative to the world's most pressing medical challenges. ■

▶ For more information, please contact Jessica Lukens at 434.326.0924 or [jlukens@fusfoundation.org](mailto:jlukens@fusfoundation.org).



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Gregg Springer

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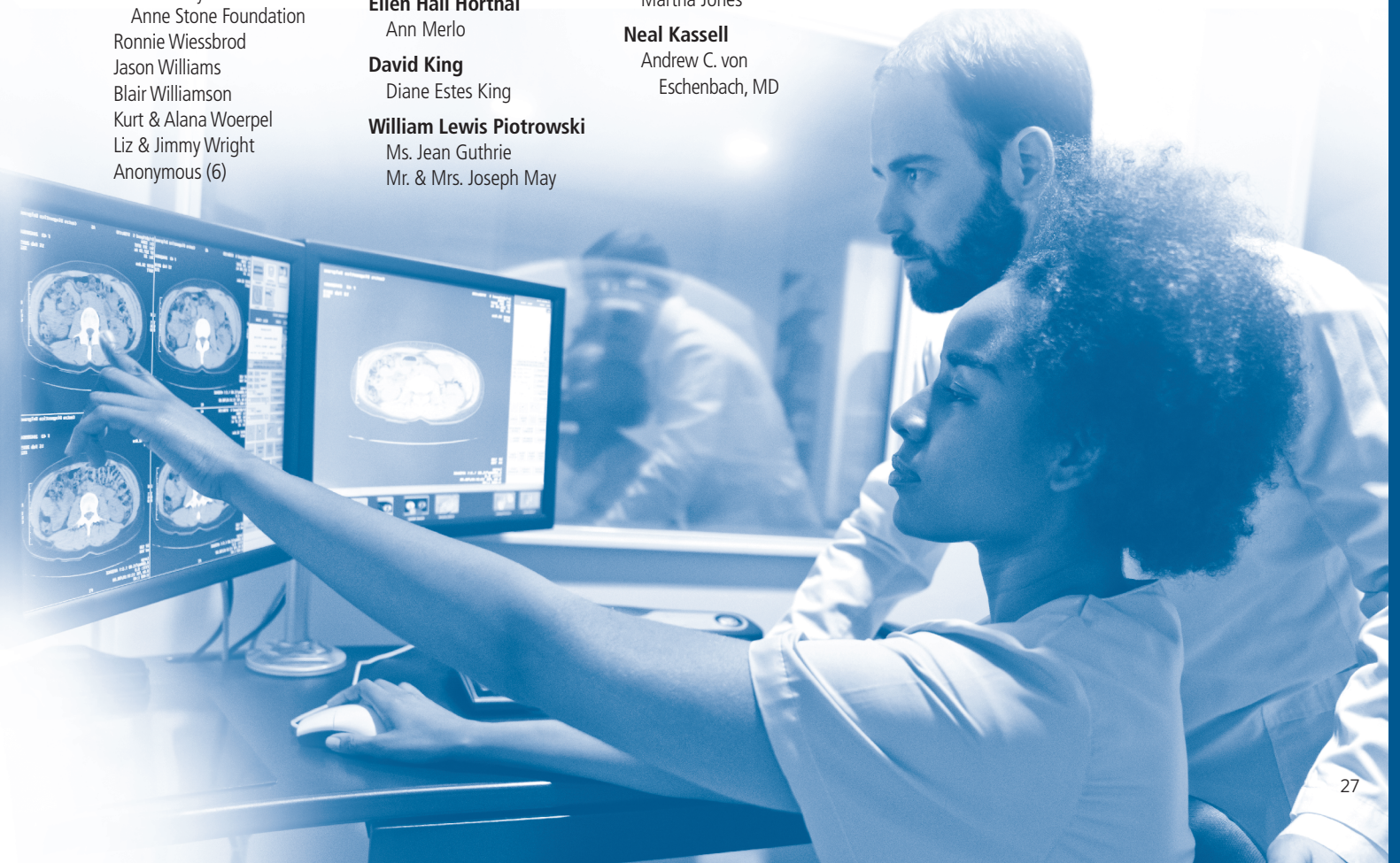
**The fund was established  
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We do our best to ensure  
every detail is right in  
thanking our donors, and  
we regret any inaccuracies.

Please contact Jessica Lukens  
at 434.326.0924 or  
jlukens@fusfoundation.org  
to make a correction.



10  
years of interns

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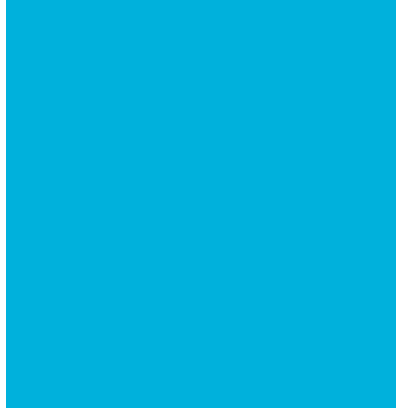
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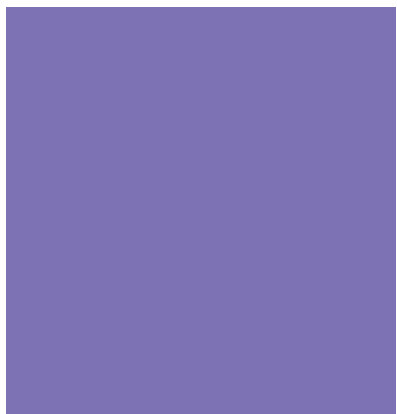


**+6<sub>K</sub>**  
patients treated  
for ET  
cumulative

**150+**  
indications



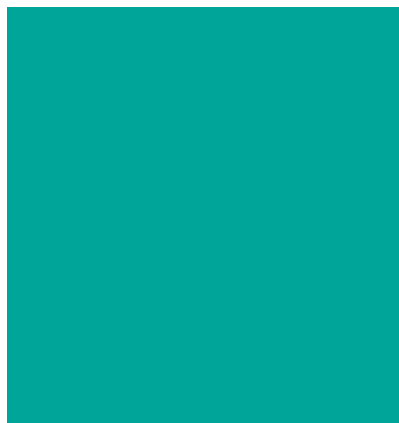
**100+**  
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