Overview

The ten research/treatment sites highlighted in this report are the Focused Ultrasound Foundation designated Centers of Excellence, COEs. They are also listed on our website.

Established in 2009, the COE program brings together the best people and technical resources at luminary sites across the globe. The Centers are created through partnerships of academia, industry, and the Foundation to showcase focused ultrasound technology and serve as hubs for collaboration. They are the powerhouses of focused ultrasound research; in 2022, they collectively published 202 scientific journal articles on their accomplishments. These sites, which include some of the most influential leaders in the field, are cultivators of the next generation of researchers and physicians for focused ultrasound and are creating the intellectual property that will spur the next iteration of commercialization efforts. We encourage you to review these pages in detail, look up the publications that might interest you, and reach out to the contacts we list for each site, if you are interested in a potential collaboration.

This portion of the 2022 State of the Field Report contains a summary of self-reported data from the COEs.
Centers of Excellence

1. University of Virginia Health System
2. The Institute of Cancer Research and The Royal Marsden
3. Brigham and Women’s Hospital
4. University of Maryland School of Medicine
5. Sunnybrook Health Sciences Centre
6. Stanford University School of Medicine
7. Inserm - LabTAU
8. Physics for Medicine Paris
9. Children’s National Hospital
10. University Medical Center Utrecht

Locations
### Centers of Excellence

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Established</th>
</tr>
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<tbody>
<tr>
<td>University Medical Center Utrecht</td>
<td>Utrecht, The Netherlands</td>
<td>2020</td>
</tr>
<tr>
<td>Children’s National Hospital</td>
<td>Washington, DC</td>
<td>2020</td>
</tr>
<tr>
<td>Physics for Medicine Paris</td>
<td>Paris, France</td>
<td>2019</td>
</tr>
<tr>
<td>Inserm - LabTAU</td>
<td>Lyon, France</td>
<td>2017</td>
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<tr>
<td>Stanford University School of Medicine</td>
<td>Stanford, CA</td>
<td>2016</td>
</tr>
<tr>
<td>Sunnybrook Health Sciences Centre</td>
<td>Toronto, Canada</td>
<td>2016</td>
</tr>
<tr>
<td>University of Maryland School of Medicine</td>
<td>Baltimore, MD</td>
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</tr>
<tr>
<td>Brigham and Women’s Hospital</td>
<td>Boston, MA</td>
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</tr>
<tr>
<td>The Institute of Cancer Research and The Royal Marsden</td>
<td>London, England</td>
<td>2013</td>
</tr>
<tr>
<td>University of Virginia Health System</td>
<td>Charlottesville, VA</td>
<td>2009</td>
</tr>
</tbody>
</table>
University Medical Center Utrecht | The Netherlands

The University Medical Center Utrecht, UMC Utrecht, is the fourth Center of Excellence in Europe. UMC Utrecht is striving to improve current cancer therapy with MRI-guided focused ultrasound, often in combination with other modalities, such as radiotherapy, chemotherapy, and surgery, leading to higher efficacy, fewer side effects, and lower costs. The emphasis of the clinical translation, in close collaboration with other nearby medical centers and international consortia, is on breast cancer, bone cancer, immune stimulation, and drug delivery for brain tumor treatment.

Contacts
Helena M Verkooijen, MD, PhD, Program Co-director | h.m.verkooijen@umcutrecht.nl
Clemens Bos, PhD, Program Co-director | c.bos@umcutrecht.nl
Chrit T.W. Moonen, PhD, Program Co-director | c.moonen@umcutrecht.nl

Commercial treatments
- Musculoskeletal: Bone metastases, Desmoid tumors
- Women’s health: Endometriosis, Uterine fibroids

Clinical research
- Cardiovascular: Peripheral artery disease
- Musculoskeletal: Bone metastases, Desmoid tumors
- Women’s health: Breast tumors, malignant; Uterine fibroids

Preclinical research
- Miscellaneous: Head & neck tumors
- Neurological: Pontine glioma

Mechanisms of action research
- Histotripsy: Immunomodulation, Tissue destruction
- Hyperthermia: Drug delivery, Radiosensitization
- Nonthermal: BBB opening; BBB opening, drug delivery; Drug delivery; Drug delivery, vehicle; Immunomodulation; Liquid biopsy; Tissue destruction
- Thermal ablation: Tissue destruction

Technical research
- Drug delivery technology
- FUS Image guidance, MR
- FUS Image guidance, Ultrasound
- FUS Physics
- FUS Transducer technology, Histotripsy
- FUS Treatment monitoring
Publications—2022


Publications—2022 continued


Focused Ultrasound and RadioTHERapy for non-invasive palliative pain treatment in patients with bone metastasis: a study protocol for the three armed randomized controlled FURTHER trial. Slotman DJ, Bartels MMTJ, Ferrer CJ, Bos C, Bartels LW, Boomsma MF, Phernambuq ECJ, Nijholt IM, Morganti AG, Siepe G, Buwenge M, Grull H, Bratke G, Yeo SY, Blanco...
Children’s National Hospital | Washington, DC

In September 2020, Children’s National Hospital, CNH, in Washington, DC, became the first Center of Excellence focused exclusively on pediatrics. The COE includes a multidisciplinary team of clinicians and investigators from radiology, oncology, surgery, orthopedics, neurosurgery, and urology. In recent years, the CNH team has become a leader in the translation of focused ultrasound for treating pediatric solid tumors. They are currently investigating the treatment of malignant solid tumors with focused ultrasound alone and combined with chemotherapy. Moving forward, the team plans to further explore oncological applications of focused ultrasound, particularly to augment chemotherapy and immunotherapy for hard-to-treat pediatric cancers.

Contacts
Karun V. Sharma, MD, PhD | Program Co-director | kvsharma@cnmc.org
AeRang Kim, MD, PhD | Program Co-director | aekim@childrensnational.org

Commercial treatment
Musculoskeletal Osteoid osteoma, Soft tissue cancer

Clinical research
Gastrointestinal Liver tumors
Miscellaneous Multiple tumors
Musculoskeletal Bone metastases, Osteoid osteoma, Soft tissue cancer
Neurological Brain tumors, general; Neurofibromatosis; Pontine glioma

Preclinical research
Musculoskeletal Osteoid osteoma, Soft tissue cancer

Mechanisms of action research
Histotripsy Immunomodulation, Tissue destruction
Hyperthermia Tissue destruction
Nonthermal Drug delivery, vehicle; Neuromodulation
Thermal ablation Immunomodulation, Tissue destruction

Technical research
Drug delivery technology
FUS Image guidance, MR
FUS Image guidance, Navigation
FUS Image guidance, Ultrasound
FUS Simulation & treatment planning
FUS Transducer technology, Histotripsy
FUS Treatment evaluation
FUS Treatment monitoring
Standards & quality assurance

1 Protocols inclusive of more than one indication
Children’s National Hospital continued

### Research not involving thermal ablation, tissue destruction

<table>
<thead>
<tr>
<th>Clinical research - Miscellaneous</th>
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<tbody>
<tr>
<td>Multiple tumors[^1]</td>
<td>Hyperthermia - Chemosensitization</td>
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<td>Hyperthermia - Drug delivery</td>
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<td>Bone metastases</td>
<td>Thermal ablation - Chemosensitization</td>
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<tr>
<th>Clinical research - Neurological</th>
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<tbody>
<tr>
<td>Pontine glioma</td>
<td>Nonthermal, BBB opening - Drug delivery</td>
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<tr>
<td></td>
<td>Nonthermal - Sonodynamic therapy</td>
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</table>

<table>
<thead>
<tr>
<th>Preclinical research - Musculoskeletal</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft tissue cancer</td>
<td>Histotripsy - Immunomodulation</td>
</tr>
</tbody>
</table>

### Publications—2022


[^1]: Protocols inclusive of more than one indication
Physics for Medicine Paris

Physics for Medicine Paris | France

In December 2019, Physics for Medicine Paris became the third Center of Excellence in Europe. The site focuses on accelerating the development of ultrasound-based technologies and translating these innovative technologies to the clinic, with an emphasis on cardiovascular and neurological disorders. Physics for Medicine Paris is a technological hub for new modalities of ultrasound guidance, monitoring, and treatment. The team also undertakes the training of many PhD students, assuring it a pivotal role in the education of young researchers.

Contacts
Mickael Tanter, PhD | Program Director | mickael.tanter@espci.fr
Jean-François Aubry, PhD | Scientific Director | jean-francois.aubry@espci.fr

Mechanisms of action research
- Histotripsy: Tissue destruction
- Nonthermal: BBB opening, drug delivery; Neuromodulation
- Thermal ablation: Tissue destruction

Technical research
- Drug delivery technology
- FUS Image guidance, MR
- FUS Image guidance, Navigation
- FUS Image guidance, Ultrasound
- FUS Physics
- FUS Simulation & treatment planning
- FUS Transducer technology, Histotripsy
- FUS Transducer technology, Thermal ablation
- FUS Treatment monitoring

Research not involving thermal ablation, tissue destruction

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<th>Preclinical research</th>
<th>Cardiovascular</th>
<th>Heart valve calcifications</th>
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</thead>
<tbody>
<tr>
<td>Preclinical research</td>
<td>Neurological</td>
<td>Depression; Parkinson’s disease, underlying cause</td>
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</table>

Preclinical research

<table>
<thead>
<tr>
<th>Cardiovascular</th>
<th>Heart valve calcifications</th>
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<tbody>
<tr>
<td>Neurological</td>
<td>Depression; Parkinson’s disease, underlying cause</td>
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</tbody>
</table>
Physics for Medicine Paris continued

Publications—2022 continued


In February 2017, INSERM Unit 1032, the Laboratory of Therapeutic Applications of Ultrasound, LabTAU, at the French National Institute for Health and Medical Research, INSERM, was named a Focused Ultrasound Center of Excellence. LabTAU conducts significant translational and clinical research with a multidisciplinary, highly qualified, and complementary team of physicians and scientists. The COE has special expertise in commercializing technology and creating strategic interfaces between engineering and medicine.

**Contact**
Cyril Lafon, PhD | Program Director | cyril.lafon@inserm.fr

**Commercial treatment**
Urological: Prostate cancer, Hôpital Edouard Herriot

**Clinical research**
Cardiovascular: Varicose veins
Neurological: Glioblastoma, Hôpitaux Universitaires Pitié-Salpêtrière & Hôpital Pierre Wertheimer
Urological: Prostate cancer, Hôpital Edouard Herriot
Women’s health: Endometriosis, Hôpital Croix-Rousse

**Preclinical research**
Cardiovascular: Twin-twin transfusion syndrome, Ventricular tachycardia
Gastrointestinal: Liver tumors; Pancreatic tumors, malignant
Musculoskeletal: Osteoradionecrosis
Neurological: Cancer pain
Ophthalmological: Presbyopia
Urological: Prostate cancer
Women’s health: Breast tumors, malignant; Endometriosis

**Mechanisms of action research**
Histotripsy: Tissue destruction
Nonthermal: BBB opening; BBB opening, drug delivery; Chemosensitization; Drug delivery; Immunomodulation; Neurmodulation; Sonodynamic therapy; Sonoporation; Tissue destruction
Thermal ablation: Tissue destruction

**Technical research**
Drug delivery technology
FUS Image guidance, MR
FUS Image guidance, Ultrasound
FUS Physics
FUS Simulation & treatment planning
FUS Transducer technology, Other
FUS Treatment monitoring
Research not involving thermal ablation, tissue destruction

**Clinical research - Cardiovascular**
Varicose veins  
Thermal ablation - Vascular occlusion

**Clinical research - Neurological**
Glioblastoma  
Nonthermal, BBB opening
Nonthermal, BBB opening - Drug delivery

**Preclinical research - Gastrointestinal**
Pancreatic tumors, malignant  
Nonthermal - Drug delivery
Nonthermal - Sonodynamic therapy
Nonthermal - Tissue destruction
Thermal ablation - Immunomodulation

**Preclinical research - Neurological**
Cancer pain  
Nonthermal - Neuromodulation

**Preclinical research - Ophthalmological**
Presbyopia  
Nonthermal - Tissue destruction

**Preclinical research - Women’s health**
Breast tumors, malignant  
Nonthermal - Immunomodulation

Publications—2022


Publication—2022 continued


Stanford University School of Medicine | California

Established in 2016, Stanford’s COE focuses on several clinical and preclinical projects. These include industry-sponsored trials using focused ultrasound to treat bone metastases, uterine fibroids, essential tremor, and prostate cancer, as well as investigator-initiated trials to treat soft tissue tumors. Preclinical projects have included developing referenceless methods for MR (Magnetic Resonance) thermometry in the brain and respiratory-compensated focused ultrasound in treatment of porcine liver during free-breathing. These clinical and preclinical projects involve close collaboration with colleagues in radiology, obstetrics and gynecology, medical and radiation oncology, neurosurgery, neurology, orthopedic surgery, urology, pathology, immunology, and electrical and mechanical engineering.

Contacts
Pejman Ghanouni, MD, PhD | Program Co-director | ghanouni@stanford.edu
Kim Butts Pauly, PhD | Program Co-director | kbpauly@stanford.edu

Commercial treatments
<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions</th>
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<tr>
<td>Cardiovascular</td>
<td>Arteriovenous malformations</td>
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<td>Musculoskeletal</td>
<td>Bone cancer, Bone metastases, Desmoid tumors,</td>
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<td>Osteoid osteoma</td>
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<tr>
<td>Neurological</td>
<td>Essential tremor; Parkinson’s disease, tremor</td>
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<tr>
<td>Urological</td>
<td>Prostate cancer</td>
</tr>
<tr>
<td>Women’s health</td>
<td>Uterine adenomyosis, Uterine fibroids</td>
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</tbody>
</table>

Stanford University | California
University of California Davis | California

A collaboration between Stanford and UC Davis investigating the use of focused ultrasound for the treatment of liver cancer in canines is underway. The research team is using focused ultrasound to deliver microRNA to the tumors, demonstrating efficient drug delivery and a significant change in the immunogenicity of the tumor.

Veterinary Research

4

Focused Ultrasound Foundation | 2023 State of the Field
## CENTERS OF EXCELLENCE

Stanford University School of Medicine continued

### Technical research

<table>
<thead>
<tr>
<th>Topic</th>
<th>Areas of Focus</th>
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<tbody>
<tr>
<td>Drug delivery technology</td>
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</tr>
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<td>FUS Image guidance, MR</td>
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<td>FUS Physics</td>
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<td>FUS Transducer technology, Nonthermal</td>
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<td>FUS Transducer technology, Thermal ablation</td>
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<td>FUS Treatment evaluation</td>
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<td>FUS Treatment monitoring</td>
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### Research not involving thermal ablation, tissue destruction

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<tr>
<th>Clinical research - Gastrointestinal</th>
<th>Thermal ablation - Immunomodulation</th>
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<td>Pancreatic tumors, malignant</td>
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<th>Thermal ablation - Immunomodulation</th>
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<td>Pancreatic tumors, malignant</td>
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<td>Melanoma</td>
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<td>Muscle atrophy</td>
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<td>Epilepsy</td>
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<td>Glioblastoma</td>
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<td>Neuropathic pain</td>
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<td>Breast tumors, malignant</td>
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<td>Ovarian tumors</td>
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<th>Nonthermal - Drug delivery, vehicle</th>
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<td>Liver tumors</td>
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### Mechanisms of action research

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<th>Hyperthermia</th>
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<td>Drug delivery, Drug delivery, immunotherapeutic;</td>
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<tr>
<td>Drug delivery, vehicle</td>
<td>Gene delivery; Neuromodulation; Sonoporation; Stem cell delivery; Stem cell trafficking; Tissue destruction</td>
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<th>Amplification of cancer biomarkers, Chemosensitization, Immune cell trafficking, Immunomodulation, Tissue destruction</th>
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<tbody>
<tr>
<td>Publications—2022</td>
<td>Publications—2022 continued</td>
</tr>
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</tbody>
</table>
Publications—2022


**Sunnybrook Health Sciences Centre**

Established as a COE in 2016, the Sunnybrook Health Sciences Centre is conducting research for focused ultrasound in neurology, neurosurgery, urology, orthopedics, gynecology, radiation oncology, and biomedical engineering, and has studies underway for Alzheimer’s disease, obsessive-compulsive disorder, depression, Parkinson’s disease, ALS, breast cancer brain metastases, and others.

**Contacts**

Nir Lipsman, MD, PhD | Clinical Research Director | nir.lipsman@utoronto.ca  
Kullervo Hynynen, PhD | Scientific Director | khynynen@sri.utoronto.ca

**Commercial treatment**

<table>
<thead>
<tr>
<th>Category</th>
<th>Disease</th>
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<tbody>
<tr>
<td>Neurological</td>
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<tr>
<td>Urological</td>
<td>Prostate cancer</td>
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**Clinical research**

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<tr>
<td>Miscellaneous</td>
<td>Head &amp; neck tumors</td>
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<tr>
<td>Musculoskeletal</td>
<td>Bone cancer</td>
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<tr>
<td>Neurological</td>
<td>Alzheimer’s disease; Amyotrophic lateral sclerosis; Brain metastases, breast cancer; Brain metastases, lung cancer; Depression; Essential tremor; Glioblastoma; Multiple sclerosis; Obsessive-compulsive disorder; Pontine glioma</td>
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<tr>
<td>Urological</td>
<td>Prostate cancer</td>
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<tr>
<td>Women’s health</td>
<td>Breast tumors, malignant</td>
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**Preclinical research**

<table>
<thead>
<tr>
<th>Category</th>
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<tr>
<td>Cardiovascular</td>
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<tr>
<td>Gastrointestinal</td>
<td>Colorectal tumors</td>
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<tr>
<td>Musculoskeletal</td>
<td>Bone metastases</td>
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<tr>
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<tr>
<td>Ophthalmological</td>
<td>Retinal injury</td>
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<tr>
<td>Women’s health</td>
<td>Breast tumors, malignant</td>
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</tbody>
</table>
Sunnybrook Health Sciences Centre continued

### Mechanisms of action research

| Hyperthermia | Drug delivery, radiosensitization |
| Nonthermal | BBB opening; BBB opening, drug delivery; Chemosensitization; Clot lysis; Drug delivery; Drug delivery, immunotherapeutic; Neuromodulation; Sonoporation; Stem cell delivery; Vascular occlusion |
| Thermal ablation | Immune cell trafficking, Tissue destruction |

### Technical research

- Drug delivery technology
- FUS Image guidance, MR
- FUS Image guidance, Ultrasound
- FUS Physics
- FUS Simulation & treatment planning
- FUS Transducer technology, Histotripsy
- FUS Transducer technology, Hyperthermia
- FUS Transducer technology, Nonthermal
- FUS Transducer technology, Other
- FUS Transducer technology, Thermal ablation
- FUS Treatment monitoring
- Standards & quality assurance

### Research not involving thermal ablation, tissue destruction

#### Clinical research - Gastrointestinal
- Pancreatic tumors, malignant
  - Nonthermal - Drug delivery
  - Nonthermal - Immunomodulation

#### Clinical research - Miscellaneous
- Head & neck tumors
  - Hyperthermia - Radiosensitization
  - Nonthermal - Radiosensitization

#### Clinical research - Neurological
- Alzheimer’s disease
  - Nonthermal, BBB opening - Drug delivery
- Amyotrophic lateral sclerosis
  - Nonthermal, BBB opening - Drug delivery
- Brain metastases, breast cancer
  - Nonthermal, BBB opening - Drug delivery
- Brain metastases, lung cancer
  - Nonthermal, BBB opening - Drug delivery, immunotherapeutic
- Glioblastoma
  - Nonthermal, BBB opening - Drug delivery
  - Nonthermal - Liquid biopsy
- Pontine glioma
  - Nonthermal, BBB opening - Drug delivery, immunotherapeutic

#### Clinical research - Women’s health
- Breast tumors, malignant
  - Hyperthermia - Radiosensitization
  - Nonthermal - Radiosensitization

#### Preclinical research - Cardiovascular
- Deep vein thrombosis
  - Histotripsy - Tissue destruction

#### Preclinical research - Neurological
- Alzheimer’s disease
  - Nonthermal, BBB opening - Drug delivery
  - Nonthermal, BBB opening - Gene delivery
- Amyotrophic lateral sclerosis
  - Nonthermal, BBB opening - Drug delivery
- Brain metastases, breast cancer
  - Nonthermal, BBB opening - Drug delivery
- Epilepsy
  - Nonthermal - Neuromodulation
- Glioblastoma
  - Nonthermal, BBB opening - Drug delivery
- Parkinson’s disease, underlying cause
  - Nonthermal, BBB opening - Drug delivery
- Spinal cord injury
  - Nonthermal, BBB opening - Drug delivery
- Stroke, intracerebral hemorrhage
  - Nonthermal, BBB opening - Drug delivery
- Stroke, thromboembolic
  - Nonthermal, BBB opening - Drug delivery

#### Preclinical research - Ophthalmological
- Retinal injury
  - Nonthermal - Gene delivery
Publications—2022


CEN TERS OF EXCELE NCE

Sunnybrook Health Sciences Centre continued

Publications—2022 continued


**University of Maryland School of Medicine | Baltimore, MD**

The COE at the University of Maryland, UMD, was established in 2016. At present, the UMD departments of neurosurgery, radiology, and neurology are collaborating to study the treatment of movement disorders, chronic neuropathic pain, brain tumors, and the use of enhanced drug delivery. In addition, their immunomodulation studies range from investigating cell systems to animal models and human clinical trials.

**Contacts**

Howard M. Eisenberg, MD | Program Co-director | heisenberg@som.umaryland.edu

Elias R. Melhem, MD | Program Co-director | emelhem@umm.edu

**Commercial treatment**

**Neurological**

Essential tremor; Parkinson’s disease, tremor

**Clinical research**

**Neurological**

Brain metastases, lung cancer; Glioblastoma; Trigeminal neuralgia

**Preclinical research**

**Miscellaneous**

Infection

**Neurological**

Brain tumors; general; Epilepsy; Glioblastoma; Opioid and other addictions

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**Mechanisms of Action**

| **Histotripsy** | Immune cell trafficking |
| **Nonthermal** | BBB opening; BBB opening, drug delivery; BBB opening, drug delivery, immunotherapeutic; Chemosensitization; Immunomodulation; Liquid biopsy; Neuromodulation; Radiosensitization; Sonodynamic therapy; Tissue destruction |
| **Thermal ablation** | Tissue destruction |

**Technical research**

| **Drug delivery technology** |
| **FUS Image guidance; MR** |
| **FUS Image guidance; Ultrasound** |
| **FUS Physics** |
| **FUS Simulation & treatment planning** |
| **FUS Treatment monitoring** |
| **Standards & quality assurance** |
University of Maryland School of Medicine continued

**Research not involving thermal ablation, tissue destruction**

**Clinical research - Neurological**
- Brain metastases, lung cancer: Nonthermal, BBB opening - Drug delivery, immunotherapeutic
- Glioblastoma: Nonthermal - Liquid biopsy

**Preclinical research - Miscellaneous**
- Infection: Nonthermal, BBB opening - Drug delivery

**Preclinical research - Neurological**
- Brain tumors, general: Nonthermal - Amplification of cancer biomarkers, BBB opening
- Glioblastoma: Nonthermal - Liquid biopsy
- Epilepsy: Nonthermal - Gene delivery
- Glioblastoma: Nonthermal - Liquid biopsy

**Opioid and other addictions**
- Nonthermal - Neuromodulation

**Publications—2022**


**Publications—2022 continued**


Brigham and Women’s Hospital

Brigham and Women’s Hospital | Boston, MA

Brigham and Women’s Hospital was named a COE in 2015. More than 50 focused ultrasound researchers in three different laboratories span the Boston campus of Brigham and Women’s Hospital where, in conjunction with Harvard Medical School, they are pioneering innovative uses of focused ultrasound and advancing these new approaches from bench to bedside.

Contacts

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Commercial treatments

Musculoskeletal Bone metastases
Neurological Essential tremor
Urological Prostate cancer
Women’s health Uterine fibroids

Clinical research

Neurological Epilepsy, Glioblastoma
Urological Prostate cancer

Preclinical research

Niemann-Pick disease
Alzheimer’s disease; Epilepsy; Glioblastoma;
Huntington’s disease; Parkinson’s disease, tremor

Mechanisms of action research

Hyperthermia Tissue destruction
Nonthermal Amplification of cancer biomarkers;
BBB opening, drug delivery; BBB opening, gene delivery;
Drug delivery, vehicle; Immunomodulation;
Liquid biopsy; Neuromodulation; Radiosensitization;
Stem cell delivery; Tissue destruction

Thermal ablation Tissue destruction

Technical research

FUS Image guidance, MR
FUS Image guidance, Ultrasound
FUS Physics
FUS Simulation & treatment planning
FUS Treatment evaluation
FUS Treatment monitoring
Brigham and Women’s Hospital continued

**Research not involving thermal ablation, tissue destruction**

**Clinical research - Neurological**

- Epilepsy
  - Nonthermal - Neuromodulation
- Glioblastoma
  - Nonthermal, BBB opening - Drug delivery

**Preclinical research - Miscellaneous**

- Niemann-Pick disease
  - Nonthermal, BBB opening - Gene delivery

**Preclinical research - Neurological**

- Alzheimer’s disease
  - Nonthermal, BBB opening - Drug delivery
- Epilepsy
  - Nonthermal - Neuromodulation
- Glioblastoma
  - Nonthermal, BBB opening - Drug delivery
- Huntington’s disease
  - Nonthermal, BBB opening - Drug delivery
- Parkinson’s disease, tremor
  - Nonthermal - Neuromodulation

**Publications—2022**


**Publications—2022 continued**


<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Journal/Conference</th>
<th>Volume/Issue</th>
<th>Page Numbers</th>
<th>DOI/PMID</th>
</tr>
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</table>
The Institute of Cancer Research and The Royal Marsden | London, England

In 2013, the Focused Ultrasound Foundation and Philips entered an innovative public-private collaboration with the Institute of Cancer Research, ICR, and The Royal Marsden National Health Service Foundation Trust to create a COE in London. The Center created a state-of-the-art resource for clinicians and scientists working on focused ultrasound therapy, developing clinical evidence in oncology, and establishing best practices, treatment standards, and protocols.

1 Veteran Research

Mechanisms of action research
- Histotripsy: Tissue destruction
- Hyperthermia: Drug delivery, Radiosensitization
- Nonthermal: Chemosensitization; Drug delivery; Drug delivery, immunotherapeutic; Tissue destruction; Vascular occlusion
- Thermal ablation: Immune cell trafficking, Immunomodulation, Tissue destruction

Technical research
- Drug delivery technology
- FUS Image guidance, MR
- FUS Image guidance, Ultrasound
- FUS Physics
- FUS Simulation & treatment planning
- FUS Transducer technology, Thermal ablation
- FUS Treatment monitoring
- Standards & quality assurance
ICR and The Royal Marsden continued

Research not involving thermal ablation, tissue destruction

**Clinical research - Gastrointestinal**
- Colorectal tumors
  - Nonthermal - Drug delivery

**Preclinical research - Cardiovascular**
- Twin-twin transfusion syndrome
  - Nonthermal - Vascular occlusion

**Preclinical research - Gastrointestinal**
- Pancreatic tumors, malignant
  - Nonthermal - Immunomodulation

**Preclinical research - Neurological**
- Glioblastoma
  - Nonthermal - Drug delivery, vehicle

**Veterinary research - Urological**
- Bladder tumors
  - Thermal ablation - Immunomodulation

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**Publications—2022**


**University of Virginia Health System | Charlottesville, VA**

The Foundation’s first COE was inaugurated at the University of Virginia in September 2009 through a public private partnership between the Foundation, the Commonwealth of Virginia, the University of Virginia, Insightec, and GE. The COE has a strong history in brain research, having pioneered clinical trials for essential tremor and Parkinsonian tremor, as well as technical and preclinical studies for neurological disorders. The center also treats uterine fibroids and bone metastases and conducts cancer research.

### Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
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### Commercial Treatments

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### Clinical Research

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<td>Pulmonary</td>
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<td>Breast tumors, benign; Breast tumors, malignant; Cervical tumors; Ovarian tumors</td>
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### Preclinical Research

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<tr>
<td>Gastrointestinal</td>
<td>Pancreatic tumors, malignant</td>
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1 Protocols inclusive of more than one indication.
Mechanisms of action research

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<tr>
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<td>Histotripsy</td>
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<td>Chemosensitization, Immunomodulation, Tissue destruction</td>
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Technical research

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<td>FUS Treatment evaluation</td>
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1 Inclusive of more than one indication

Research not involving thermal ablation, tissue destruction

<table>
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Publications—2022


The University of Virginia
Focused Ultrasound Cancer Immunotherapy Center
Charlottesville, VA

In 2022, UVA Health and the Focused Ultrasound Foundation launched the Focused Ultrasound Cancer Immunotherapy Center, the world’s first center dedicated specifically to advancing a focused ultrasound and cancer immunotherapy treatment approach that could revolutionize 21st-century cancer care. The center is designed to capitalize on UVA’s strengths including cancer immunotherapy, focused ultrasound, and medical imaging.

<table>
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\(^1\) Inclusive of more than one indication
Publications—2022 continued


